

OFFICIAL PUBLICATIONS OF CORNELL UNIVERSITY

VOLUME VII

NUMBER 5

ANNOUNCEMENT OF THE GRADUATE SCHOOL 1916-17

FEBRUARY 1, 1916
PUBLISHED BY CORNELL UNIVERSITY
ITHACA, NEW YORK

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CALENDAR

1916-17

FIRST TERM

Sept. 28, 1916.	Instruction begins.
Sept. 30, 1916.	Registration of graduate students.
Dec. 19, 1916.	Last day for announcing titles of theses by candidates for advanced degrees in June.
Feb. 7, 1917.	Last day for completing requirements for advanced degrees to be conferred in February.

SECOND TERM

Feb. 12, 1917.	Registration of graduate students.
Mar. 15, 1917.	Last day for filing applications for fellowships and graduate scholarships.
June 15, 1917.	Last day for completing requirements for advanced degrees to be conferred at Commencement.
June 20, 1917.	Commencement.

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The abbreviations in parentheses indicate the colleges to whose special announcements prospective graduate students are referred for more detailed information concerning advanced work in the various subjects. See page 16. A. & S. = College of Arts and Sciences; Agr. = College of Agriculture; Arch. = College of Architecture; C.E. = College of Civil Engineering; M.E. = Sibley College of Mechanical Engineering; Med. = Medical College; N. Y. Med. = Medical College in New York City; Vet. = Veterinary College; Chem. = Department of Chemistry.

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THE GRADUATE SCHOOL

ADMISSION

The Graduate School has exclusive control of all graduate work carried on in the University. Graduates of the following colleges of Cornell University, namely, the College of Arts and Sciences, the Medical College, the College of Architecture, the College of Civil Engineering, the Sibley College of Mechanical Engineering, and the New York State College of Agriculture, and also graduates of other institutions in which the requirements for the first degree are substantially equivalent, are eligible for admission to the Graduate School. In other cases, studies pursued after graduation, and experience gained by professional work or otherwise, are taken into consideration in deciding whether the candidate's preparation as a whole is such as to justify his admission to the Graduate School. Graduates of colleges other than those of Cornell University may be admitted to the Graduate School, but not to candidacy for an advanced degree, if their training is regarded as less than one year short of that required for the first degree at Cornell University.

In order to be admitted to the Graduate School, a student must furnish evidence that he has already received a first degree, by presenting either a diploma or a statement from some official source. The simplest procedure will ordinarily be to submit an official statement from the registrar or dean that the degree has been conferred. In the case of graduates of Cornell University this is not necessary, since the records are conveniently accessible.

To avoid delays at the beginning of the academic year, those who desire to enter the Graduate School are advised to make application for admission, either in person or by letter, in the preceding spring or summer. Correspondence should be addressed to the Dean of the Graduate School, Cornell University, Ithaca, New York.

Seniors in the colleges of Cornell University who have completed the work required for the Bachelor's degree may, under certain conditions to be ascertained from the deans of their respective colleges, be admitted to the Graduate School.

REGISTRATION

Students who have been admitted to the Graduate School are required to register at the office of the Registrar of the University and in the office of the Graduate School at the beginning of each term, unless special permission for later registration has been granted by the Dean.

STUDIES

In carrying on studies in the Graduate School, the student is expected to assume the initiative and the responsibility. All courses of study offered in the University, and all the facilities for study and investigation afforded by its libraries, museums and laboratories are open to graduate students in so far as they are qualified to make use of them. It is important, however, to recognize from the beginning that graduate work does not consist in the fulfillment of routine requirements, and that the various opportunities for study, as well as

the advice and assistance of teachers, are to be regarded simply as aids to the student in acquiring for himself the discipline and method of independent scholarship.

A brief statement of the provision made for graduate work by the various departments of the University will be found in this Announcement. A list of courses which are deemed likely to be of profit to graduate students is set down under the announcement of each department. More detailed information regarding these courses than is here given will be found in the separate Announcement of the college in which the particular course is given. The latest edition of the special Announcements of the various colleges may be obtained on application to the Secretary of the University.

The purpose of the Graduate School is to provide the student with the method and discipline of original research, to the ultimate end that he may contribute to the advancement of knowledge. In furnishing this opportunity for independent study and investigation, the Graduate School seeks to make the conditions such as will enable the student to devote himself wholly to his chosen field. Unhampered by restrictions that necessarily obtain in undergraduate work, he will come into freedom of association with older scholars, who will seek to make his work profitable to him by giving such aid and direction as he may need. Inasmuch as subjects differ greatly, the requirements for all subjects cannot be stated in terms at once specific and uniform. In some departments of knowledge original research may begin with the student's entrance into the School; in other subjects much preliminary work is necessary to fit the students for profitable research.

The branch of knowledge to which the student intends to devote the larger part of his time is termed his Major Subject. The other fields of study selected, which will be necessarily more restricted in their scope, and which should in general be selected with reference to their direct bearing upon the major subject, are termed the Minor Subjects. Candidates for the Doctor's degree are required to select a major subject and two minor subjects; for a Master's degree, a major subject and one minor subject are required.

In the case of candidates for an advanced degree, a statement of the major and minor subjects, approved by the teachers under whose direction the work is taken, must be presented to the Dean not later than two weeks after admission to the Graduate School. In the case of graduate students who are not candidates for an advanced degree, a detailed statement of the studies selected must be filed in the Dean's office not later than two weeks after registration. This statement must be endorsed by a member of the Faculty who is selected by the student to act as his adviser.

CANDIDACY FOR AN ADVANCED DEGREE

For a student who has been admitted to candidacy for an advanced degree the minimum time of residence for a Master's degree is one year, and for the Doctor's degree three years.

Not all students admitted to the Graduate School may expect to complete the residence requirement for an advanced degree in the minimum time. Those whose undergraduate work has been insufficient in amount or too narrowly specialized, as well as those whose preparation in their special field is inadequate,

must count upon spending some time in the preliminary studies which are essential as a basis for the advanced study and investigation which they propose to undertake. Moreover, it should also be remembered that the minimum residence requirement applies only to graduates of a four-year course in some college of Cornell University, and to graduates of other institutions who have pursued an equivalent course of study.

The conditions for admission to candidacy for an advanced degree are:

(a) The candidate's training must be substantially equivalent to that required for the first degree in one of the four-year courses at this University. Candidates for one of the advanced technical degrees, M.C.E., M.M.E., M.Arch., M.F., M.L.D., and M.S. in Agr., must have had the equivalent of the corresponding first degree at Cornell University.

(b) The candidate must receive the recommendation of his special committee that he is qualified to undertake such advanced work as the Faculty will accept for the degree.

SPECIAL COMMITTEES

The work of each candidate for an advanced degree is in charge of a committee consisting of the teachers under whom his major and minor subjects are pursued, the representative of his major subject being chairman. The student is expected to confer freely with the members of his special committee, not only in connection with individual courses of study, but also in regard to the general plan of his work.

THE MASTERS' DEGREES

Cornell University confers the degrees of Master of Arts, Master of Architecture, Master of Civil Engineering, Master of Mechanical Engineering, Master in Forestry, Master in Landscape Design, and Master of Science in Agriculture.

After admission to candidacy for a Master's degree, the student must spend at least one year* in residence at this University, pursuing under the direction of his special committee a course of advanced study including one major and one minor subject.

Each candidate must present a thesis, or essay, as the chairman of his special committee may decide, which shall demonstrate his ability to do independent work, and which shall be acceptable in style and composition. After this thesis, or essay, has been duly presented and is accepted by the Special Committee, the candidate is required to present himself for examination on his major and minor subjects and on the subject matter of his thesis.

A statement of the general subject of the thesis, or essay, with the written approval of the chairman of the special committee in charge of the candidate's work, must be furnished the Dean at least six months before the date at which the degree is to be conferred.

The completed thesis, or essay, approved by the special committee, must be presented to the Dean at least five days before the examination for the degree,

*In the case of graduate students who at the same time hold appointments as instructors or assistants in Cornell University, the minimum time of residence required for a Master's degree is increased by one-third. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate work will also be required to devote more than the minimum time to their study for the Master's degree.

An instructor or assistant, who has completed at least one term of satisfactory graduate work at another university, may, however, upon the recommendation of his special committee, satisfy the residence requirement for the Master's degree by one year at Cornell.

and must remain on file until the day preceding the examination. When the major subject for the degree of Master of Architecture is in Design, the candidate is required to deposit in place of the thesis, either the original drawings, or a photographic reproduction of them.

Each candidate for a Master's degree is required to furnish a bound typewritten copy of his thesis, or essay, for the use of the University Library, and this copy is to be delivered to the Dean not less than five days before the degree is to be conferred. The size of the page in the case of the typewritten thesis should be 8 x 10½ inches. This copy of the thesis becomes the permanent property of the Library.

Examinations for a Master's degree may be written or oral, or both, at the option of the examining committee, and are open to all members of the Faculty. The examination for the degree of Master of Architecture may be waived by the General Committee of the Graduate School in any case, where, in the opinion of the student's special committee, the major and minor subjects are of such nature as to make an examination impossible or inexpedient.

THE DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred upon a candidate who, after completing not less than three years of resident graduate work, presents a satisfactory thesis, and passes an examination on one major and two minor subjects, and on the subject matter of his thesis. Each candidate for the Doctor's degree is also required to deposit one hundred printed copies of his thesis with the Dean for the use of the University Library.

A candidate for the degree of Doctor of Philosophy is required to demonstrate his fitness by the presentation of a thesis which shall exhibit power of independent investigation, and by passing the required examinations on the fields represented by the major and minor subjects in which he has carried on his studies during his term of residence. The Doctor's degree, however, is intended to represent, not a specified amount of work covering a specified time, but the attainment, through long study, of independent and comprehensive scholarship in special fields. The standard for the Doctor's degree is determined by the attainment to be expected of a student of ability and adequate preparation who devotes his entire time for three years to study and research, under proper supervision, in the field of study marked out by one major and two minor subjects.

A candidate for the Doctor's degree will ordinarily be expected to have a working knowledge of French and German before beginning graduate work. In all cases he must, before beginning his second year of residence, show to the satisfaction of his special committee that he possesses a reading knowledge of these languages. If the subjects chosen by a candidate are of such a character as to make it desirable that he should be familiar with some foreign language other than French and German, the special committee may, with the consent of the Dean, permit the substitution of that language for one of the two required.

The candidate is required to spend at least three years*, after admission to candidacy, in resident graduate study and investigation of an advanced character.

*In the case of graduate students who at the same time hold appointments as instructors or assistants in Cornell University, the minimum time of residence for the Doctor's degree is four years. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate work will also be required to devote more than the minimum time to their study for the Doctor's degree.

Residence as a graduate student in another university may, by permission of the Faculty, be accepted as the equivalent of residence at Cornell University. No general statement can be made regarding the conditions under which this permission will be granted; each case will be decided on its merits. A request for credit for resident work elsewhere must be approved by the student's special committee. At least one year's residence in Cornell University is required in all cases.

Residence for a Master's degree may be credited toward the residence required for the degree of Doctor of Philosophy provided the special committee in charge of the work approves, certifying the work done as suitable for the Doctor's degree.

A statement of the general subject of the thesis, with the written approval of the chairman of the special committee in charge of the candidate's work, is to be furnished the Dean at least six months before the date at which the degree is to be taken. The thesis for the Doctor's degree must be of such a character as to demonstrate the candidate's ability to do original work, and must be satisfactory in style and composition. The completed thesis, approved by the special committee, is to be presented at the office of the Graduate School at least five days before the examination for the degree, and must remain on file until the day preceding the examination.

Each candidate for the Doctor's degree is required to deposit one hundred printed copies of his thesis in the office of the Dean of the Graduate School for the purposes of the University Library. In exceptional cases this requirement may be met by depositing with the Dean for the purposes of the University Library a bound typewritten copy of the thesis, and one hundred printed copies of such a summary and such portion of the thesis, as may be recommended by the chairman of the special committee and approved by the General Committee.

When all the other requirements for the doctorate have been fulfilled, the degree may be conferred before the printed copies of the thesis have been received, provided that the candidate present to the Dean, not less than five days before the degree is to be conferred, a bound typewritten copy of the thesis, together with a signed statement that publication will take place within a definite period, which period shall not exceed two years; and provided further that he deposit at the same time with the Treasurer of the University the sum of seventy-five dollars. The Treasurer is authorized to accept at his discretion as a guarantee a regularly executed bond instead of the deposit of money. The deposit will be returned if the prescribed number of printed copies of the thesis is furnished within the stated time. But, in case the printed copies are not delivered within such time, the University reserves the right to use the deposit to defray the expense of printing the thesis or such portions of it as the Faculty may direct.

The candidate should consult with the Dean regarding the form of publication of the thesis. The thesis shall have both a cover and a title page. The title page must include the printed statement that the thesis is presented to the Faculty of the Graduate School of Cornell University for the Degree of Doctor of Philosophy. If the thesis is a reprint, the place and date of the original publication must be given.

The attention of present and former graduate students of Cornell University is called to an arrangement whereby theses, which have been accepted in ful-

fillment of the requirements for the doctorate at Cornell University, may be published (at the expense of the authors) through the office of the Secretary of the University. The advantages of this arrangement to the writer of a thesis are: prompt and satisfactory publication, with the likelihood of moderate expense and the certainty of good printing; conformity of the individual thesis to a good style of typography and binding; ease of distribution, with the higher probability that a thesis will be sought and found when it is one of a series than when it is privately and separately published.

The writer whose thesis has been accepted by his special committee, and who wishes to avail himself of the arrangement in question, should apply to the chairman of that committee who will make the necessary arrangements for publication through the chairman of the editorial committee.

To be distinguished from a candidate's special committee, which has charge of his examination and the preparation of a thesis, is the editorial committee which, under the arrangement described, will have charge of the publication of the thesis. This consists, in each case, of three members: the Dean of the Graduate School, the chairman of the special committee, and Professor Lane Cooper, the chairman of the editorial committee.

Examinations for the Doctor's degree may be either oral or written, or both, at the option of the examining committee, and are open to all members of the Faculty. A list giving the dates of the examinations and the members of the examining committees will be issued early in May.

Ordinarily the examination for the Doctor's degree follows the acceptance of the thesis and is held not earlier than the close of the sixth term of residence. If, however, the special committee certifies to the Dean that the candidate has made satisfactory progress on his thesis and that it would be of advantage to have the examination precede the presentation of the thesis, the examination may be held at some date, set by the Dean, not earlier than two weeks before the close of the fifth term of residence. This examination must be followed by an examination, before the special committee as a whole, on the general subject matter of the thesis at such time as may be designated by the Dean after the completed thesis has been duly presented in the office of the Graduate School. In the event of failure in this earlier examination, no re-examination can be held until three months after the completion of the minimum period of residence.

DATES FOR CONFERRING DEGREES

Advanced degrees are conferred in February, June, and September.

In February, degrees will be conferred on students who have made application for the degree on or before the first day of instruction after the Christmas recess, and who have completed the requirements not later than the last day of the final term examinations.

In June, degrees will be conferred on students who have made application for the degree not later than May 15th, and who have completed the requirements not later than the last day of the final term examinations.

*The size of the page in case of typewritten theses should be 8 x 10½ inches. This copy of the thesis becomes the permanent property of the Library.

In September, degrees will be conferred on students who have made application for the degree not later than September 1st, and who have completed the requirements not later than the day preceding the first day of instruction of the first term.

GRADUATE WORK IN THE SUMMER

(A). **The Summer Session.** Work done in the Summer Session of Cornell University, under the direction of a member of the Faculty of the Graduate School, may be counted for residence toward the degree of Master of Arts under the following conditions: one term's residence to be satisfied by two summer sessions, and two terms' residence by four summer sessions. Candidates for this degree who are in residence during Summer Sessions only are required also to continue their studies during the year under the direction of the Chairman of the Special Committee in charge of their work.

It should be noted that in some departments no graduate work is offered in the Summer Session. A statement of the graduate work offered will be found in the Announcement of the Summer Session, which will be sent on application to the Secretary.

(B). **The Third Term.** A Third Term of full length, extending from early in June until late in September, is offered by certain departments in the College of Agriculture. For the purposes of graduate residence this term is regarded as equivalent to one of the terms of the academic year. No candidate for the Doctor's degree, however, will be credited with more than two terms of residence during any twelve consecutive months, and no candidate will be recommended for this degree at an earlier date than if all of his work had been done during the regular sessions of the academic year. The Announcement of this Third Term may be secured by application to the Secretary of the University.

(C). **Personal Direction.** An opportunity is offered to properly qualified students of certain subjects to carry on graduate studies during the summer months under the personal direction of members of the Faculty of the Graduate School. The general library and many of the laboratories and special libraries of the University are open during this period, and certain members of the instructing staff, who remain in residence during the summer, are willing to assume responsibility for the supervision of the work of students who are qualified to carry on investigations. It is impossible to make any announcement in advance as to what opportunities for graduate work may be found at any definite time in a particular subject; but such information may be obtained by correspondence.

Residence towards an advanced degree for work carried on under personal direction during the summer will be granted only if the following conditions are complied with:

1. Members of the Faculty of the Graduate School who are prepared to undertake the direction during the summer months of the studies of graduate students who are registered neither in the Summer Session nor in the Third Term, may obtain authorization for such work by making application to the General Committee not later than May 1st of each year. An application for such authorization should contain a statement of the amount and character of the supervision that the member of the Faculty is prepared to give, and of the number of months or weeks during which the work is to continue.

2. A student who has already completed at least a full year of graduate work as a candidate for an advanced degree, either in this University or in some institution whose graduate work is acceptable, may receive residence credit for work thus authorized. It should, however, be understood that this provision for residence credit is in all cases limited by the general rule that no candidate for the Doctor's degree will receive credit for more than two terms of residence during any twelve consecutive months.

(D). Under conditions to be ascertained from the Dean, instructors in Cornell University who are also registered in the Graduate School may receive credit for work done without compensation during the summer months away from the University.

All students pursuing graduate studies during the summer under any of the provisions described in the foregoing paragraphs are required to register at the office of the Dean of the Graduate School before beginning work.

FELLOWSHIPS AND GRADUATE SCHOLARSHIPS

The following twenty-five fellowships are annually offered in the Graduate School:

1. The Cornell Fellowship in English.
2. The McGraw Fellowship in Civil Engineering.
3. The Sage Fellowship in Chemistry.
4. The Schuyler Fellowship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.
5. The Sibley Fellowship in Mechanical and Electrical Engineering.
6. The Goldwin Smith Fellowship in Botany; Geology; or Physical Geography.
7. The President White Fellowship in Physics.
8. The Erastus Brooks Fellowship in Mathematics.
9. The University Fellowship in Architecture.
10. The University Fellowship in Romance Languages.
11. The University Fellowship in German.
12. The University Fellowship in Agriculture.
13. The University Fellowship in Mechanical and Electrical Engineering.
14. The President White Fellowship in Modern History.
15. The President White Fellowship in Political and Social Science.
- 16-17. The Susan Linn Sage Fellowships in Philosophy.
18. The Susan Linn Sage Fellowship in Psychology.
- 19-20. The Fellowships in Political Economy.
- 21-22. The Fellowships in Greek and Latin.
23. The Fellowship in American History.
24. The Jacob H. Schiff Fellowship in German.
25. The Edgar J. Meyer Memorial Fellowship in Engineering Research.

The President White Fellowships in Modern History and in Political and Social Science have an annual value of \$500 each; the others have an annual value of \$400 each. All Fellows are also exempt from tuition.

The following seventeen graduate scholarships are annually offered in the Graduate School:

- 1-5. The Susan Linn Sage Graduate Scholarships in Philosophy.
6. The Susan Linn Sage Graduate Scholarship in Psychology.
7. The Graduate Scholarship in Mathematics.
8. The Graduate Scholarship in Chemistry.
9. The Graduate Scholarship in Physics.
10. The Graduate Scholarship in Civil Engineering.
11. The Graduate Scholarship in Latin and Greek.
12. The Graduate Scholarship in Archaeology and Comparative Philology.
13. The Graduate Scholarship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.
14. The Graduate Scholarship in Botany; Geology; or Physical Geography.
15. The Graduate Scholarship in English.
16. The Graduate Scholarship in History.
17. The Graduate Scholarship in Architecture.

The graduate scholarships, with the exception of the Scholarship in Architecture, have an annual value of \$200 each. Holders of graduate scholarships are also exempt from tuition. The Graduate Scholarship in Architecture grants only free tuition.

All persons elected to fellowships and graduate scholarships are required, upon accepting their appointments, to file a bond that, in case of their resignation before the expiration of the time for which they were appointed, they will repay to the University any sums that they may have received. The bond must be for the value of the fellowship or the scholarship and must have two sureties approved by the Treasurer of the University.

In view of the fact that experience in conducting classes will be of value in training fellows and scholars for future usefulness, each holder of a fellowship or graduate scholarship shall be liable to render service to the University in the work of instruction or examination to the extent of four hours a week through the academic year.

The moneys due on fellowships and graduate scholarships are paid at the office of the Treasurer of the University in six equal payments on October 15th, December 1st, January 15th, February 15th, April 1st, and May 15th.

The term of each fellowship and graduate scholarship is one year; but the term may under exceptional circumstances be extended to two years.

On the recommendation of the Faculty of the Graduate School, a fellowship may be divided for a single year into two graduate scholarships, the value of each to be one-half of the divided fellowship. But no fellowship may be thus divided oftener than once in two years.

The President White Fellowships in History and Political Science may, in the discretion of the Faculty of the Graduate School, be made travelling fellowships. In the case of a student of very exceptional ability and promise in the fields of either of these fellowships, the two fellowships may, in the discretion of the Faculty, be combined for a single year into one.

The Jacob H. Schiff Fellowship in German may also, in the discretion of the Faculty of the Graduate School, be made a travelling fellowship.

Official forms for making application for fellowships and graduate scholarships may be obtained from the Dean of the Graduate School. All applications should be filed in the office of the Dean on or before March 15 of the academic year preceding the one for which application was made. Before this application is filed, the applicant should have convinced himself by correspondence that he is eligible for admission to the Graduate School of this University in full standing, since appointments are made only to those who are eligible for admission to candidacy for an advanced degree.

All other information, papers, and testimonials should be submitted on or before March 15 to the department in which the applicant desires to carry on the principal part of his work. Applicants are advised to submit any published or unpublished papers or reports showing the result of their study or research which might serve to indicate the extent of their knowledge of the subject, or their command of the methods and tools of research, or their capacity generally for clear written expression. Candidates who are graduates of other colleges or universities should submit recommendations from the instructors best acquainted with their ability and attainments. It should be borne in mind that information cannot be too exact or detailed in the case of students not personally known to the appointing body.

Honorary Fellowships

Persons upon whom the Doctor's degree has already been conferred may, in the discretion of the Faculty of the Graduate School, be appointed to honorary fellowships. These fellowships cover all fees except laboratory charges. Actual residence at the University and regular registration in the Graduate School are required of appointees.

THE GRADUATE PRIZE IN PHILOSOPHY

The Graduate Prize in Philosophy has an annual value of about twenty-five dollars, and is open for competition to all students registered in the Graduate School of Cornell University.

1. The prize will be awarded to the graduate student who submits the best paper embodying the results of research in the field of philosophy. To be acceptable, the paper must show independent scholarship and research in dealing with philosophical ideas. The subject of the paper may be either historical or critical and constructive in character. It may be concerned either with problems of pure philosophy or with the philosophical bearing of the concepts and methods employed in mathematics or in any of the natural or humanistic sciences.

2. Papers submitted in competition must be deposited in the office of the Dean of the Graduate School on or before the first day of May. Each paper is to be typewritten, and must bear a fictitious signature and be accompanied by the name of the writer in a sealed envelope.

3. The prize will be awarded by a committee appointed by the President of the University. A copy of the successful paper is to be deposited in the University Library by the Dean of the Graduate School.

FEES

A matriculation fee of \$5 is charged all students on entering the University.

Every student (except those registered in the Medical College in New York City) is charged an Infirmary fee of \$3 a term, payable at the beginning of each term. In return for the Infirmary fee, any sick student is, on his physician's certificate, admitted to the Infirmary, or in the discretion of the Infirmary Committee, to the Ithaca City Hospital, if receivable under its rules. He is given without further charge a bed in a ward, board, and ordinary nursing, for a period not exceeding two weeks in any one academic year. Extra charges are made for private rooms, special foods, and special nurses. If a sick student who has not received two weeks' service in the year is refused admittance to either the Infirmary or the City Hospital, by reason of lack of accommodation, he is entitled to a refund of the fee for both terms.

A graduation fee of \$20 is required of each person about to take an advanced degree. This fee must be paid at least ten days before the date on which the degree is to be conferred. The amount will be refunded should the degree not be conferred.

Every person taking laboratory work or laboratory courses must pay to the Treasurer the fee or the deposit for the materials to be used in the work.

The tuition charged in the different colleges of the University is as follows:

Medical College		\$150
College of Arts and Sciences		125
College of Law		125
Veterinary College	{ For free tuition { see below }	100
College of Agriculture		125
College of Architecture		150
College of Civil Engineering		150
Sibley College		150
Summer Session		30

The tuition of graduate students who are candidates for a degree is in general that of the college in which the major subject lies, with the exception that a graduate student whose major subject is in the College of Agriculture, where tuition is free for all graduate work, must if he takes a minor subject in another college pay therefor one-sixth of the tuition prevailing in that college. For each minor subject taken in the College of Agriculture by a student whose major subject is in another college, one-sixth of the tuition will be deducted.

The tuition of students not candidates for a degree is determined on the basis of the tuition rates prevailing in the colleges in which the studies are taken.

After the academic year 1914-15, tuition is free to all who hold fellowships and scholarships in the Graduate School.

Instructors and assistants who are registered in the Graduate School are allowed to take, without the payment of tuition, such work in any college as is approved by their special committees, it being understood that the major subject shall be in the line of work in which they are instructing. Members of the instructing staff who are registered as graduate students shall be exempted from the payment of laboratory, shop, and agricultural fees in courses taken or in research pursued in the Department in which they are employed to give instruction.

All tuition and other fees may be changed or increased by the Trustees to take effect at any time without previous notice.

Students upon registering become liable for the tuition fee for the term.

The \$100 tuition fee is payable in installments of \$55 at the beginning of the first term and \$45 at the beginning of the second term; the \$125 fee is payable similarly in installments of \$70 and \$55; the \$150 fee, in installments of \$85 and \$65; in the Medical College in New York City, the entire fee is payable at the beginning of the year.

THE UNIVERSITY LIBRARIES

WILLARD AUSTEN, Librarian; A. C. WHITE, Assistant Librarian; E. R. B. WILLIS, Superintendent, Readers' Division; W. W. ELLIS, Superintendent, Stacks and Department Libraries; G. L. BURR, Librarian of the President White Library; E. E. WILLEVER, Librarian of the Law Library; H. HERMANNSSON, Curator of the Icelandic Collection; Miss M. FOWLER, Curator of the Petrarch and Dante Collections.

The University Library comprises the General Library of the University, the eight Seminary Libraries, the Law Library, the Flower Veterinary Library, the Barnes Reference Library, the Goldwin Smith Hall Library, the Stimson Hall Medical Library, and the Library of the New York State College of Agriculture. The total number of bound volumes in them is now about four hundred and sixty thousand, and is increasing at the rate of about fourteen thousand volumes a year. The number of periodicals, transactions, and other serials, currently received, is over two thousand, and of most of these complete sets are on the shelves. The General Library of the University and seven Seminary Libraries are all grouped under one roof in the Library Building, while the remaining collections are to be found in the buildings devoted to their respective subjects.

Among the more important special collections in the General Library may be mentioned: THE ANTHON LIBRARY, of nearly seven thousand volumes, the collection made by the late Professor Charles Anthon, of Columbia College, in the ancient classical languages and literatures, besides works in history and general literature; THE BOPP LIBRARY, of about twenty-five hundred volumes, relating to the oriental languages and literatures, and comparative philology, being the collection of the late Professor Franz Bopp of the University of Berlin; THE GOLDWIN SMITH LIBRARY, of thirty-five hundred volumes, comprising chiefly historical works and editions of the English and ancient classics, presented to the University in 1869 by the late Professor Goldwin Smith, and increased during later years by the continued liberality of the donor; THE PUBLICATIONS of the Patent Office of Great Britain; about three thousand volumes; THE WHITE ARCHITECTURAL LIBRARY, a collection of over twelve hundred volumes relating to architecture and kindred branches of science, given by ex-President White; THE KELLY MATHEMATICAL LIBRARY, comprising eighteen hundred volumes and seven hundred tracts, presented by the late Hon. William Kelly, of Rhinebeck; THE SPARKS LIBRARY, being the library of Jared Sparks, sometime President of Harvard University, consisting of upward of five thousand volumes and four thousand pamphlets, relating chiefly to the history of America; THE MAY COLLECTION, relating to the history of slavery and anti-slavery, the nucleus of which was formed by the gift to the library of the late Rev. Samuel J. May, of Syracuse; THE SCHUYLER COLLECTION of folk-lore, Russian history and literature, presented by the late Hon. Eugene Schuyler in 1884; THE PRESIDENT WHITE HISTORICAL LIBRARY, of about twenty thousand volumes (including bound collections of pamphlets) and some three thousand unbound pamphlets, the gift of ex-President White, received in 1891, especially rich in the primary sources of history, and containing notable collections on the period of the Reformation, on the English and French Revolutions, on the American Civil War, and on

the history of superstition; **THE SPINOZA COLLECTION**, numbering four hundred and fifty volumes, presented in 1894, by ex-President White; the four remarkably rich collections given by the late Willard Fiske, comprising the **DANTE COLLECTION**, containing seven thousand six hundred volumes, the **PETRARCH COLLECTION**, containing about four thousand volumes, the **RHAETO-ROMANIC COLLECTION**, containing about thirteen hundred volumes, and the **ICELANDIC COLLECTION**, containing over ten thousand volumes; **THE ZARNCKE LIBRARY**, containing about thirteen thousand volumes and pamphlets, especially rich in Germanic Philology and literature, purchased and presented in 1893 by William H. Sage; **THE HERBERT H. SMITH COLLECTION** of books relating to South America, purchased in 1896; a valuable collection of books on French and Italian Society in the 16th and 17th centuries, presented by Professor T. F. Crane in 1896; **THE FLOWER VETERINARY LIBRARY**, the gift of ex-Governor Flower to Cornell University, for the use of the State Veterinary College, in 1897; **THE EISENLOHR LIBRARY**, containing about one thousand volumes on Egyptology and Assyriology purchased and presented in 1902 by A. Abraham; **BAYARD TAYLOR'S** correspondence and journals and his collection of Goethe literature, presented to the Library in 1905 by Mrs. Marie Taylor; the valuable **ANGLO-SAXON COLLECTION** and the **COWPER COLLECTION** formed by the late Professor Hiram Corson, bequeathed to the Library, and received in 1911; the large **ENGLISH COLLECTION** presented by Professor J. M. Hart in 1914.

THE LAW LIBRARY of forty-seven thousand volumes contains an unusually complete collection of American, English, and Colonial reports, with complement of textbooks and statutes, and complete sets of all the leading periodicals in English.

These collections and others such as these, making possible an exhaustive study of certain fields, are of the greatest service in research work. A similar purpose is served by the seminary rooms of the University Library. Thus, for the study of English, of the classical languages, of the Germanic and Romance languages, of philosophy, of politics and economics, of American and of European history, there have been provided in the library building seven of these research rooms, each equipped with a carefully chosen body of reference books, to which advanced students in these fields have access. In connection with the scientific and technical laboratories similar collections have been formed, well supplied with reference books, standard works, and sets of periodicals, conveniently arranged for study and research.

Cards of admission to the shelves in the stackrooms and to the White Historical Library will be issued by the Librarian to graduate students for the purpose of consultation and research. The privilege of taking books for home use is granted to all students who comply with the library regulations.

COURSES OF INSTRUCTION AND OTHER OPPORTUNITIES FOR GRADUATE STUDY

The courses outlined in the following pages are grouped primarily on the basis of subject matter. Under each subject there is usually given, in a separate paragraph, a list of courses which are probably too elementary in character to interest graduate students of that subject. There then follows a list of all those courses which, whether open or not open to undergraduates, are deemed likely to be of profit to graduate students.

More detailed information concerning any one of these various courses (time and place of meeting, and, in the case of a few courses given in alternate years, whether or not offered in 1916-1917, etc.) will be found in the separate announcement of the college in which the particular course is given. The last edition of these special announcements of the various colleges may be obtained on application to the Secretary of the University.

SEMITIC LANGUAGES AND LITERATURES

Professor: NATHANIEL SCHMIDT.

Special facilities for advanced work in this subject are: 1. a collection of several hundred squeezes of inscriptions found in Syria and Arabia Petraea, chiefly in Arabic, Hebrew, Syriac, Assyrian, Nabataean, and Greek; 2. squeezes of Old Egyptian Coptic and Hittite inscriptions; 3. a collection of several thousand photographs taken in Syria and Arabia Petraea and slides taken from these photographs; 4. reproductions of inscriptions and objects of art in the Museum of Casts; 5. a valuable collection of Arabaic, Hebrew, Samaritan, Ethiopic, and Coptic manuscripts secured in Syria; 6. the Eisenlohr Library, especially rich in Egyptology; 7. the Fiske collection of Arabic books; 8. a growing collection of Egyptian antiquities.

To the candidate for an advanced degree opportunities are offered of studying every Semitic language and dialect, and also Sumerian, Old Egyptian, and Coptic. The student may, if he so chooses, specialize in Semitic literature or in Oriental history. A candidate for the Master's degree or the Doctor's degree with Semitic languages as a major subject, must have had a year of elementary Hebrew or Arabic; and a candidate for either of these degrees, with Oriental history as a major subject, must have had one year of ancient history and one year either of the history of Asia or the history of Africa, before entering upon the graduate course.

Advanced Hebrew.

Neo-Hebraic.

Ethiopic.

Assyrian.

Sumerian.

Aramaic (Mandaic, Babylonian Talmudic, Syriac, Nabataean, Palmyrene, Galilaeen, Samaritan and Judaeen).

Arabic (Sabaean and Minaean, Classical Modern).

Egyptian.

Coptic.

Comparative Semitic Philology.

Semitic Epigraphy (in Semitic Seminary).

Hebrew Literature (in Semitic Seminary).

The History of Asia

The History of Africa

The Sources of Oriental History (in Historical Seminary).

GREEK

Professors: G. P. BRISTOL; H. L. JONES.

Reader: A. C. WHITE.

The general library and the special library of over two thousand volumes in the seminary rooms afford ample facilities for graduate work. The special library is rich in complete sets of philological and archaeological periodicals in various languages, and contains all the standard works that form the laboratory apparatus of the graduate student. Other books will be transferred from the general library to the seminary rooms as they are needed.

The one essential preparation for graduate work is the ability to read Greek. To gain this the student should pursue the subject throughout his undergraduate course, reading the largest possible amount of Attic prose literature. A good knowledge of Latin and of German is indispensable, and the ability to read French and Italian very helpful. All courses offered in Greek are open to any graduate student, but not all courses will be accepted as graduate work leading to a degree.

Elementary Greek with Xenophon; Selections from Plato and the Odyssey; Herodotus; Demosthenes, Aeschylus, Sophocles; Greek Composition; Thucydides; The New Testament; Lyric poetry.

The Myths of the Epic Cycle. Assistant Professor JONES.

Advanced Greek Composition. Assistant Professor JONES.

The Orestean Tragedies of Aeschylus, Sophocles, and Euripides. Assistant Professor JONES.

Greek Seminary. Homer, Oratory, History, or Philosophy. Professor BRISTOL.

Comparative and Historical Grammar. Professor BRISTOL.

Linguistics and Prehistory. Professor BRISTOL.

Introduction to the Science of Language. Professor BRISTOL.

GREEK ART AND ANTIQUITIES

Professor: E. P. ANDREWS.

The Museum of Casts furnishes abundant material for the study of Greek sculpture and for most branches of Greek archaeology. Several hundred squeezes bring the most important Greek inscriptions within reach for independent work in Greek epigraphy. The University Library contains complete sets of the most important archaeological periodicals.

Ability to read French and German as well as Greek and Latin, is assumed. A scholarship in archaeology and comparative philology is awarded annually.

History of Greek Sculpture; Greek Archaeology.

Pausanias.

Modern Greek.

Greek Epigraphy, in Seminary.

Greek Archaeology, in Seminary.

History of Greek Sculpture.

LATIN

Professors: C. E. BENNETT; H. C. ELMER; C. L. DURHAM.

Graduate students in Latin have the use of the Latin seminary, consisting of two rooms in the University Library. The seminary contains several thousand volumes of texts and other works of reference, including complete sets of all the journals of classical philology. Two Greek and Latin fellowships and one scholarship are annually awarded.

Elementary Latin; Livy, Cicero, Horace; Sight Translation; Virgil's Aeneid, Books I-VI; Latin Conversation and Oral Composition; Terence, Horace, Tacitus; Sight Translation for sophomores; Catullus, Virgil, Ovid, Martial; Classic Myths in English Literature; Cicero's Letters, Cicero de Oratore, Book I; Cicero's De Officiis, Cicero's Second Philippic; Palutius, Lucretius, Lectures on the History of Roman Literature; Suetonius, Pliny, Tacitus; Intermediate Course in Latin Writing; Teacher's Training Course; Roman Private and Political Antiquities; Cicero in Verrem; Virgil's Aeneid, Books VII-XII.

Latin Seminary. Professor BENNETT.

History, Aim, and Scope of Latin Studies. Professor BENNETT.

Historical Latin Syntax. Professor BENNETT.

Historical Grammar of the Latin Language. Professor BENNETT.

Latin Writing, Advanced Course. Professor ELMER.

History and Development of Roman Epic Poetry. Professor ELMER.

Vulgar Latin. Professor DURHAM.

Latin Epigraphy. Professor DURHAM.

Carmina Latina Epigraphica. Professor DURHAM.

GERMAN

Professors: A. B. FAUST; P. R. POPE; H. C. DAVIDSEN; A. W. BOESCHE.

Instructors: A. L. ANDREWS; W. D. ZINNECKER; C. VOLLMER.

In the advanced courses in this subject, the work is twofold, literary and philological. The history of German literature from the earliest period to the present day is given in outline lecture courses with collateral reading. Special topics are selected for more minute study, such as the epic and lyrical poetry of the Middle High German period, the literature of the Reformation, the classical period, the romantic school, the modern drama. The courses offered in philology include the study of Gothic, Old and Middle High German, and Old Norse. They afford also an introduction to the science of language and the principles of phonetics.

The seminars in German literature and philology aim to impart the principles and methods of investigation. A teachers' course deals with class-room methods and theories of instruction in the modern languages.

All the work in German is greatly facilitated by an exceptional library equipment. The nucleus was formed by the acquisition of the Zarncke library, one of the largest collections of rare books for the study of German literature and philology ever brought to America. With constant enlargements the library has become one of the most serviceable in the country. The University Library also contains the Willard Fiske collection of books on Icelandic literature, one of the most complete in existence. The German seminary room in the University Library contains books for ready reference including philological journals and reviews.

Candidates for advanced degrees in German are expected to have an adequate knowledge of French and Latin. Two fellowships in German are awarded annually.

Elementary German; Second, and Third German Course; Elementary German Composition and Conversation; Advanced German Composition and Conversation; Intermediate German Course; Scientific German.

Schiller's Life and Works. Professor BOESCHE.

Goethe's Life and Works. Professor FAUST.

Goethe's Faust. Professor FAUST.

History of German Literature. Professor FAUST.

The German Drama of the Nineteenth Century. Assistant Professor DAVIDSEN

The Literature of the Reformation. Assistant Professor DAVIDSEN.

Lessing's Life and Works. Assistant Professor DAVIDSEN.

Richard Wagner, His Life and Works. Professor POPE.

German Lyrics and Ballads. Professor POPE.

Studies in German Style. Assistant Professor DAVIDSEN.

The History of the German Element in the United States. Professor FAUST.

Elementary Phonetics and its Application to the Study of Modern Languages.

Assistant Professor DAVIDSEN.

Principles of Word-Formation. Assistant Professor DAVIDSEN.

History of the German Language. Professor BOESCHE.

Topics in Historical German Syntax. Professor BOESCHE.

Elementary Middle High German. Professor POPE.

Advanced Middle High German. Professor POPE.

Modern Scandinavian. Dr. ANDREWS.

Gothic. Professor BOESCHE.

Old High German. Professor BOESCHE.

Principles of Germanic Philology. Dr. ANDREWS.

Old Icelandic. Dr. ANDREWS.

History of Modern High German. Dr. ANDREWS.

Teacher's Course. Professor FAUST, with aid from his colleagues.

Seminary in German Literature. Professor FAUST and Assistant Professor DAVIDSEN.

Seminary in Germanic Philology. Professors POPE and BOESCHE.

The History of German Art. Professor A. WEESE. Professor of the History of Art, University of Bern, Jacob H. Schiff non-resident lecturer, 1917.

ROMANCE LANGUAGES AND LITERATURES

Professors: W. W. COMFORT; J. F. MASON; O. G. GUERLAC; G. L. HAMILTON;
R. H. KENISTON; L. PUMPELLY.

Instructors: J. MCF. CARPENTER, JR.; G. H. BROWN; D. F. JACKSON; C. STURGIS.

The collection of French books in the University Library is very large, and offers excellent facilities for advanced work. The Spanish library, though in large measure recently acquired, is quite representative. Objects of special pride are the unrivalled Dante and Petrarch collections, the gift of the late Willard Fiske, who likewise presented to the University a unique collection of Rhaeto-Romance works. Smaller collections of Portuguese and Provençal books are also to be found in the University Library. The seminary library contains several thousand volumes including many sets of bound periodicals. A university fellowship (of the value of \$400 and free tuition) in Romance languages is annually awarded.

The courses of study in this department are divided into three categories: those intended primarily for undergraduates, those intended alike for undergraduates and graduates, and those intended primarily for graduates. All candidates for advanced degrees in this department must possess a thorough reading knowledge of Latin, French, and German, before announcing their candidacy. A graduate student in Romance languages should have completed some formal course of study in the language and literature of the language which he intends to select as his major subject, and should have a reading knowledge at least of the languages which he selects as his minor subjects.

A candidate for the degree of Master of Arts whose major subject is in Romance languages is expected to present for the approval of the chairman of his special committee, within two weeks after registration day, an outline of the work planned for the year. The thesis must, before May 1st, be submitted for the criticism of the chairman of the candidate's special committee. If not already taken, a course in the philology of the language which constitutes their major subject is required of graduate students in their first year of study. No distinction will be made between language and literature in reckoning major and minor subjects. Thus, French language and literature counts as only one subject.

Candidates for the degree of Doctor of Philosophy are expected to follow advanced courses given in the field in which their major subject lies, and to take up such work as will give a comprehensive view of the fields in which their minor subjects lie. It is intended that the last year of preparation for this degree shall be spent chiefly upon the thesis. Further information may be obtained from the professors in this department.

First Year French; Second Year French; Third Year French; Fourth Year French; Elementary French Conversation and Composition; First Year Italian; First Year Spanish.

History of French Literature. Professor COMFORT and Assistant Professor GUERLAC

French Literature of the Sixteenth Century. Professor MASON.

French Literature of the Seventeenth Century. Professor COMFORT.

French Literature of the Eighteenth Century. Assistant Professor GUERLAC.

French Literature of the Nineteenth Century. Professor MASON.
 French Dramatic Literature. Assistant Professor GUERLAC.
 French Fiction. Assistant Professor GUERLAC.
 French Lyric Poetry. Assistant Professor GUERLAC.
 Medieval French Literature. Professor COMFORT.
 Advanced French Conversation and Composition. Assistant Professor
 GUERLAC.
 French Phonetics. Assistant Professor PUMPELLY.
 French Philology. Assistant Professor PUMPELLY.
 Modern French Literature Seminary. Professor MASON.
 Second Year Italian. Assistant Professor HAMILTON.
 Petrarch and Modern Poetry. Assistant Professor HAMILTON.
 Boccaccio and Modern Prose. Assistant Professor HAMILTON.
 Dante and the Middle Ages. Assistant Professor HAMILTON.
 Spanish Literature of the Nineteenth Century. Assistant Professor KENISTON
 Spanish Classical Literature. Assistant Professor KENISTON.
 Low Latin. Assistant Professor HAMILTON.
 Comparative Romance Philology. Assistant Professor HAMILTON.
 Old French Texts. Professor COMFORT.
 Old French Phonology and Morphology. Assistant Professor HAMILTON.
 Old Spanish. Assistant Professor KENISTON.
 Spanish Seminary. Assistant Professor KENISTON.
 Portuguese Grammar and Reading. Assistant Professor KENISTON.
 Old Provençal. Assistant Professor HAMILTON.

ENGLISH

Professors: M. W. SAMPSON; W. STRUNK, JR.; LANE COOPER; F. C. PRESCOTT;
 C. S. NORTHUP; J. Q. ADAMS, JR.; B. S. MONROE.
 Instructors: E. J. BAILEY; F. M. SMITH; L. N. BROUGHTON; D. L. BALDWIN;
 A. H. GILBERT; M. G. CROWELL; J. W. HEBEL; L. H. BOULTER; M. W.
 BUNDY; J. E. JACOBY; H. A. LAPPIN.

Among the books available to the student are complete sets of the publications of the Early English Text, Chaucer, Scottish Text, Percy, English Dialect, Shakespeare, New Shakespeare, Spenser, Philological, Malone, and other societies; of the Arber, Bullen, and Grosart reprints; and of all the important periodicals dealing with the English language and literature. Most of the American and foreign dissertations on English subjects, standard and other editions of individual authors, English and American, and several special collections, are also in the Library, which is exceptionally rich in the field of Old and Middle English, and in the Elizabethan and Victorian periods. The Hart Memorial Library, founded by Professor J. M. Hart, contains valuable collections in the bibliography of English philology. This library (Morrill 32) is for the use of graduate students and members of the faculty. The department has also a seminary room in the University Library. A fellowship and a scholarship are annually awarded.

Candidates for an advanced degree may take their major subject in literature or in language. In general, thirty-six hours (i. e., three full years) of college English are required before a student may enter upon candidacy for an advanced degree. Work in philosophy, history, and languages, ancient and modern,

may, at the discretion of the candidate's special committee, be counted against a shortage in undergraduate English. Training in the Greek and Latin literatures is especially desirable as a preparation for graduate work in English. All candidates must complete a satisfactory amount of work in Old English; must have a general knowledge of English literature and English history; and must accomplish satisfactory work in research. Candidates for the Master's degree must have sufficient knowledge of French or German to make use of scholarly works in one of those languages, and candidates for the Doctor's degree must have a similar knowledge of both French and German, and a knowledge of Latin.

Introductory Course; English Poetry and Prose; Nineteenth Century Prose; Advanced Composition; Teachers' Course; Play Writing; Nineteenth Century Poetry; Greek and Latin Classics in Translation; Eighteenth Century Poetry; American Literature; Poetry and Versification.

Old English. Assistant Professor MONROE.

Early English Literary Types. Professor COOPER.

Chaucer and his Contemporaries. Professor STRUNK.

Spenser and Milton. Dr. BAILEY.

Shakespeare. Professor STRUNK.

The English Drama to 1642. Assistant Professor ADAMS.

Milton and the Epic. Dr. GILBERT.

Dante in English. Professor COOPER.

Victorian Literature. Assistant Professor NORTHUP.

Methods and Materials in the Study of English. Professor COOPER.

Spenser. Professor COOPER.

The Epic and the Romance. Assistant Professor NORTHUP.

Dramatic Structure. Professor SAMPSON.

Non-dramatic Elizabethan Literature. Assistant Professor ADAMS.

The Arthurian Legends. Assistant Professor NORTHUP.

Layamon's Brut. Assistant Professor MONROE.

Pastoral Poetry. Dr. BROUGHTON.

Principles of Literary Criticism. Professor COOPER.

Relations of English and American Literature. Assistant Professor PRESCOTT.

In addition to directing research beyond the limits of the courses listed above, the members of the instructing staff will supervise original work, either in seminars or by individual conferences, in fields here noted:

Middle English. Assistant Professor MONROE.

The Tudor-Stuart Drama. Assistant Professor ADAMS.

The Earlier Literature of the Nineteenth Century. Professor COOPER.

Middle English Literature. Assistant Professor NORTHUP.

American Literature. Assistant Professor PRESCOTT.

English Philology. Professor STRUNK.

Theory of the Drama. Professor SAMPSON.

PUBLIC SPEAKING

Professors: J. A. WINANS; G. B. MUCHMORE.

Instructors: A. M. DRUMMOND; E. J. ANDERSON; T. T. STENBERG.

Graduate students may choose Public Speaking as a minor or as a major subject for the Master's degree, or as a minor subject for the Doctorate. Studies may be undertaken in the principles of public speaking, in its psychology and its pedagogy, or in the literature and history of the subject.

Proficiency in English composition and in public speech will be presupposed. Graduate students should also have had training in psychology, literature, and history. Courses in logic and argumentation will prove helpful.

Public Speaking; Elementary; Voice Training; Oral Reading. Argumentation.

Advanced Public Speaking. Professor WINANS.

Seminary. Professor WINANS.

PHILOSOPHY AND PSYCHOLOGY

The subjects of philosophy and psychology are grouped in The Susan Linn Sage School of Philosophy. This school owes its existence to the generosity of the late Henry W. Sage, who, in addition to endowing the Susan Linn Sage philosophical professorship, made a further gift of \$200,000, for the purpose of providing permanently at Cornell University for philosophical instruction and investigation of the most varied kind and of the highest order. The endowments of the School of Philosophy enable it to secure whatever material facilities are required for the successful prosecution of philosophical studies and research. The more important philosophical and psychological journals, American and foreign, are received by the Library, which is also well equipped with philosophical and psychological works, and is particularly rich in literature relating to Plato, Spinoza and Kant.

The larger part of the work of the Sage School is adapted to the needs of graduates of this and other institutions who are preparing themselves to be teachers or investigators in philosophy and in allied fields of study. A student who has made a special study of philosophy during his junior and senior years may still take a graduate course of three years' work with history of philosophy, logic and metaphysics, ethics, or psychology, as his major subject. For the encouragement of higher studies and research in every branch represented by the School of Philosophy, there have been established three fellowships of the annual value of \$400 each, and six scholarships of the annual value of \$200 each. Holders of fellowships and graduate scholarships are exempt from the payment of tuition. Of these, one fellowship and one scholarship are regularly assigned to psychology. Applicants for fellowships and scholarships should therefore state definitely whether their major subject will be in one of the several branches of philosophy or in psychology.

The School is devoted to the free and unhampered investigation of truth in regard to all those questions of human inquiry which are embraced by logic, metaphysics, psychology, ethics, aesthetics, and the history and philosophy of

religion. In the courses of instruction are represented the chief branches and problems of philosophy. Work devoted to the thesis for the doctorate is intended to secure the maximum of specialized training and the power of independent inquiry and statement of results. In all divisions of philosophy particular stress is laid upon the historical study of philosophical ideas as the best means of securing a comprehensive grasp of fundamental problems and values.

Philosophy

Professors: J. E. CREIGHTON; Logic and Metaphysics; FRANK THILLY, Philosophy; W. A. HAMMOND, Ancient and Medieval Philosophy and Aesthetics; ERNEST ALBEE, Philosophy.

Instructor: W. K. WRIGHT, Philosophy.

The philosophical seminary room in the University Library is provided with complete sets of the leading philosophical journals, lexicons, and other books of reference, and the more important works in the several branches of philosophy and psychology. The current numbers of the philosophical journals are also to be found in the room. Liberal provision is made for the constant growth of this special library.

The Philosophical Review, established by the University, is a bi-monthly journal devoted to the interests of philosophy, embracing under that title logic, metaphysics, ethics, psychology, aesthetics, and philosophy of religion. Although supported by private endowment, it is not the organ of any institution or of any philosophical school, but by the terms of the subsidy is an absolutely free organ of contemporary philosophy. Graduate students assist by contributing summaries of periodical literature for publication in the Review, and are thus kept in close touch with the results of recent investigations in their several departments of work. In addition to this, graduate students have from time to time contributed original articles to the pages of the Review.

Under the title of Cornell Studies in Philosophy, a series of monograph studies is published from time to time as representative of the work done by graduate students in philosophy. These monographs are issued under the editorial supervision of the professors of philosophy, and consist mainly of doctoral dissertations of high quality. The series furnishes also a channel for the publication of research other than that of the thesis. Ten monographs have been issued in the series.

A full description of the courses given by the Department of Philosophy will be found in the Announcement of the College of Arts and Sciences. While any of these courses may be utilized by graduates, attendance at lectures does not constitute graduate work.

Problems of Philosophy; Logic; Fine Arts; Ethics; Moral Ideas and Practice; Renaissance; Philosophical Ideas in Nineteenth Century Literature; Theory of Evolution; History and Philosophy of Religion.

History of Philosophy. Professor CREIGHTON.

Rapid Reading of German Philosophy. Professor HAMMOND.

History of Ancient and Medieval Philosophy. Professor HAMMOND.

Types of Metaphysical Theory. Professor CREIGHTON.

Philosophical Applications and Results. Professor CREIGHTON.

- History of Ethics, Ancient, Medieval, and Renaissance. Professor HAMMOND.
 History of Modern Ethics. Professor ALBEE.
 Social and Political Ethics. Professor THILLY.
 The Ethics of Utilitarianism. Professor THILLY.
 Modern Idealistic Theories of Ethics. Professor THILLY.
 The Republic of Plato, Greek text. Professor HAMMOND.
 Aristotle's Ethics, Greek text. Professor HAMMOND.
 Thomas Aquinas. Professor HAMMOND.
 Empiricism and Rationalism in the Seventeenth and Eighteenth Centuries.
 Professor ALBEE.
 The Critical Philosophy of Kant. Professor ALBEE.
 Early Rationalism: Spinoza and Leibniz. Professor ALBEE.
 German Pessimism, with special reference to Schopenhauer. Professor
 ALBEE.
 Problems and Methods in Recent Philosophy. Professor ALBEE.
 Logical Theory: A study of Bradley, Bosanquet, Dewey, and others. Pro-
 fessor ALBEE
 Fundamental Ethical Concepts. Professor THILLY.
 Seminary in Ethics. Professor THILLY.
 Seminary in Logics and Metaphysics. Professor CREIGHTON and Dr. WRIGHT.
 Seminary in Ancient and Medieval Philosophy. Professor HAMMOND.
 Seminary in Aesthetics. Professor HAMMOND.

Psychology

Professors: E. B. TITCHENER; H. P. WELD.
 Instructors: W. S. FOSTER; E. G. BORING.

The research department of the psychological laboratory in Morrill Hall contains fifteen rooms, two of which are used as the private laboratories of the officers of instruction, one as a seminary room, and one as a workshop: the remainder are at the disposal of students for advanced work. The experimental rooms are furnished, as required, with air, gas, water, and the direct and alternating electric current; they are also connected by an elaborate wiring system, so that two or more rooms may be employed together in a single investigation. There are two dark chambers. The workshop is adequately equipped, and a skilled mechanic is in the service of the department. The laboratory possesses standard instruments of precision for all the principal modes of experiment upon human consciousness, and is especially rich on the side of acoustics. Materials are available, or can be supplied, for the study of certain problems in comparative psychology. The equipment is undergoing continual improvement, and special apparatus required for research is at once constructed or procured. The results of investigations pursued in the laboratory are published in the American Journal of Psychology.

Graduate students further have the use of the unusually complete sets of demonstrational and teaching apparatus contained in the demonstrational laboratory (Goldwin Smith Hall) and the undergraduate laboratory (Morrill Hall).

Elementary Psychology. Professor TITCHENER, Drs. FOSTER and BORING.
Experimental Psychology, Qualitative and Quantitative. Assistant Professor
WELD, Drs. FOSTER and BORING, and Mr. BISHOP.

General Psychology: Problems and Points of View. Assistant Professor
WELD.

Systematic Psychology: Sensation and Image. Assistant Professor WELD
and Dr. BORING.

Systematic Psychology: Feeling, Attention, Action. Drs. FOSTER and
BORING, and Mr. BISHOP.

Reading of German Psychology. Dr. BORING.

Reading of French Psychology. Dr. FOSTER.

Apparatus and Methods: Technique of the Laboratory. Assistant Profes-
sor WELD.

Psychological Problems, Historical and Experimental. Assistant Professor
WELD, and Drs. FOSTER and BORING.

Research Laboratory. Professor TITCHENER.

EDUCATION

Professors: —————, Science and Art of Education; D. KENNEDY
FRASER, Educational Psychology.

The educational museum contains collections illustrating the work done in various school grades, statistical charts, a full assortment of textbooks for American and German schools, including a relatively complete collection of the texts used for industrial training in the German continuation schools, an extensive high school and college exhibit of the raw materials of commerce, a kindergarten and a Montessori exhibit, and other appropriate material.

The educational laboratory has a collection of apparatus for demonstration, and of instruments of precision for research in connection with school hygiene, the experimental study of school children (with special reference to the conduct of physical and mental tests), and the psychological phases of education in general. This equipment is constantly being enlarged and apparatus needed for special investigation is at once procured. The results of investigations pursued in the laboratory are published in the *Journal of Educational Psychology*.

Graduate students selecting education as their major subject will be expected to take from one-half to two-thirds of their work in the studies that are fundamental to an adequate mastery of educational theory and practice. These fall naturally into two groups, the philosophical and the social. The philosophical studies include psychology, ethics, and the history of philosophy; the social studies include political, social, and economic science. All graduate study in education presupposes familiarity with the history and principles of education and with educational psychology. Candidates for advanced degrees whose preparation in this respect is inadequate must make up this deficiency by taking the appropriate undergraduate courses.

Principles of Education; Present Problems in Education; History of Education; Educational Psychology; School Hygiene; Elementary Education.

Psychology of the High School Period. Assistant Professor FRASER.

The Education of Exceptional Children. Assistant Professor FRASER.

Mental Tests. Assistant Professor FRASER.

Seminary for Experimental Investigation. Assistant Professor FRASER.

Reading of German Educational Psychology. Assistant Professor FRASER.

Seminary in Education. ————— and Assistant Professor FRASER.

Courses in relation to the history and principles of education and to the professional aspects of education will be offered by a professor to be appointed in these subjects.

HISTORY AND POLITICAL SCIENCE

The subjects of history and political science have been united since 1887 in the President White School of History and Political Science, which bears the name of the first president of the University, in especial recognition of the gift of his valuable collection of historical literature to the University Library.

The aims of the President White School are threefold; first, the advancement of knowledge by investigation and publication in the fields of history, economics, politics, jurisprudence, and social science; second, the training of scholars and teachers in these departments of study; third, the training of men and women for the public service, for business, and for professions such as law, journalism and philanthropy.

The School issues the Cornell Studies in History and Political Science, of which three volumes have appeared.

1. Money and Credit Instruments in their Relation to General Prices. By Edwin Walter Kemmerer, Ph.D., now Professor in Princeton University. First edition, 1907. Second edition, 1909.

2. Sargon of Assyria. By Albert Ten Eyck Olmstead, Ph.D., now Assistant Professor of History in the University of Missouri. 1908.

3. The Judicial Work of the Comptroller of the Treasury. By Willard E. Hotchkiss, Ph.D., now Dean of the School of Commerce, Northwestern University. 1910.

HISTORY

Professors: G. L. BURR, Medieval History; NATHANIEL SCHMIDT, Oriental History; C. H. HULL, American History; —————, Modern European History; H. A. SILL, Ancient History; J. P. BRETZ, American History; W. E. LUNT, Modern European History.

A graduate student in history should have a sufficient knowledge of general history and of geography. He should be able to speak and write good English. He should have a reading knowledge of French, of German, and of any other language necessary for the thorough study of his special subject. It is highly desirable that he should have had the necessary linguistic training as an undergraduate; but deficiencies in this respect may sometimes be made up after entering upon graduate work.

The University Library contains some eighty or ninety thousand volumes dealing with history. In large part these are to be found in the room known as the White Historical Library. Graduate students have immediate access to this rich group of books, which, with its many special collections, offers every facility for training in the methods of minute and exhaustive research. The historical seminary rooms in the library building are amply furnished with atlases, cyclope-

dias, dictionaries, bibliographies, and other useful works of reference, and afford easy access to the shelves of the Library proper.

It has from the outset been the policy of the University, while providing adequately for the symmetrical growth of the Library, to acquire the richer private collections of books which eminent scholars have through a lifetime of study built up as their tools of research. Thus, for the study of Oriental History, Cornell has been endowed with the EISENLOHR COLLECTION on the history of Egypt and that of President White on the history of Palestine. For the study of the Graeco-Roman world, it acquired that of Charles Anthon. For the Middle Ages, it has notable bodies of books on the birth of the Papal state, on the rise of the Carolingian empire, and, in general, on the relations of Church and State. For the Renaissance, it can boast the unrivaled FISKE COLLECTIONS on Dante and Petrarch and the world of their time. For the age of the Reformation, for the history of superstition and persecution (notably for Inquisition and Index, for the story of witchcraft, for the beginning of the sciences, for the rise of tolerance), it is equipped with the riches of the PRESIDENT WHITE LIBRARY; and for the study of the French Revolution that library has no equal on this side of the Atlantic, if anywhere outside of France. For the history of America, the University possesses the library of the historian Jared Sparks, with the MAY COLLECTION on American slavery, and the White collection on the Civil War. Professor Goldwin Smith enriched it with his working library of English history; it obtained that of Professor Tuttle on Prussia; from Professor Fiske came one singularly complete on Iceland. In a multitude of narrower fields it has been found possible to gather for the special student materials for exhaustive research. Many of these collections are endowed with special funds for their increase; and all have been steadily built up with an eye to the needs of the mature student of history.

Two fellowships and a scholarship are annually awarded to graduate students of history. The President White Fellowship in Modern European History has a value of \$500. It may be granted as a travelling fellowship. The Fellowship in American History amounts to \$400. The Graduate Scholarship in History amounts to \$200. Holders of fellowships and graduate scholarships are exempt from the payment of tuition. There are six assistantships in history, which are filled preferably by the appointment of graduate students.

The teachers and graduate students of history have formed a History Club, which meets once a month for the reading and discussion of papers on historical topics and for social intercourse.

Ancient History

Greek History; Roman History.

Greek History in the Fifth and in the Fourth Century. Professor SILL.

The Macedonian Monarchies and the Hellenistic Age. Professor SILL.

Roman History of the Revolutionary Period. Professor SILL.

The Roman Empire from Augustus to Constantine. Professor SILL.

Roman Law. Professor SILL.

Seminary in Greek and Roman History. Professor SILL.

History of Asia; History of Africa. Professor SCHMIDT. (See under Semitics.)

Medieval History

The Middle Ages (300-1300 A. D.)

Renaissance and Reformation (1300-1600). Professor BURR.

The Rise of Tolerance. Professor BURR.

Medieval Life. Professor BURR.

Seminary in Medieval History. Professor BURR.

Canon Law. Professor BURR.

Modern European History

Owing to the vacancy in this department, caused by the death of Professor Catterall, the courses for the coming year cannot yet be announced with certainty. During the past year, when the work has been only provisional, these courses were as follows:

Modern European History. 1600-1900. Dr. MELVIN.

History of the Low Countries. Dr. VAN LOON.

History of Russia. Dr. VAN LOON.

Revolutionary Europe (1789-1815). Dr. MELVIN.

Seminary in Modern European History (French Revolutionary Topics). Dr. MELVIN.

The Pathfinders of Empire. Dr. MELVIN.

Contemporary History of Europe (from 1870). Dr. VAN LOON.

English History

English Constitutional History to 1845. Professor LUNT.

English History during the Tudor Period. Professor LUNT.

English History during the Stuart Period. Professor LUNT.

English History during the Eighteenth Century. Professor LUNT.

English History from 1801 to the Present. Professor LUNT.

Selected Topics for Research in English History of the Thirteenth and Fourteenth Centuries. Professor LUNT.

American History

American History from the Period of Discovery to 1815; American History 1815-1892; Economic History of the United States (1600-1890).

Constitutional History of the Colonies and States to 1780. Professor HULL.

Constitutional History of the United States. 1780-1860. Professor HULL.

Constitutional History of the United States since 1860. Professor BRETZ.

The Settlement of the Middle West. Professor BRETZ.

History of the United States, 1860-1865. Professor BRETZ.

Seminary in American History. Professors HULL and BRETZ.

General Courses

The History of Civilization. Professors BURR, SCHMIDT, SILL and others.

The Sciences Auxiliary to History (their aims, methods, literature, and use to history). Professor BURR.

Historical Geography. Professor BURR.

Paleography and Diplomatics. Professor BURR.

Historical Method (the nature, scope, materials, and method of history).
Professor BURR.

The Teaching of History. Professor BURR, with aid from his colleagues.

Introduction to the Literature of History (a general survey, period by period,
of the sources and literature of history). Professors SCHMIDT SILL,
BURR, LUNT, HULL, and BRETZ.

POLITICAL SCIENCE

Professors: W. F. WILLCOX, Economics and Statistics; A. S. JOHNSON, Economics;
A. A. YOUNG Economics and Finance; S. P. ORTH, Politics; G. N.
LAUMAN, Rural Economy; DONALD ENGLISH, Accounting; J. R. TURNER,
Economics; R. S. SABY, Politics; R. G. BLAKEY, Economics; A. P. USHER,
Economics.

Lecturer: R. A. CAMPBELL, Economics.

Instructors: C. R. HUGINS; C. C. KOCHENDERFER; R. M. WOODBURY.

A student in economics should have as a preparation for graduate study at least the equivalent of elementary courses in economics, economic history, politics, and social science. If he has not this preparation, he should take such elementary courses as early as possible; he will not ordinarily be allowed to present this preliminary work as partial fulfilment of the requirement for a major or minor in any branch of political science. He should also have sufficient knowledge of French and German to be able to read necessary works in either language.

The work in political science in the President White School of History and Political Science falls into four divisions: economic theory, finance, statistics and social science, politics. These divisions aim to bring their work into close relationship with social, political, and business life. The members of the Faculty seek to keep in touch with the practical as well as with the purely scientific aspects of the problems treated, and have among their interests the preparation of students for positions in business and in public service.

In economic theory, a graduate course is offered in value and distribution, which is designed to familiarize the student with the main currents of contemporary economic thought. For undergraduates, courses are offered covering the principles of economics, the more general economic aspects of the labor problem, the history and theory of socialism, and the organization and methods of socialistic parties.

In finance, a research course is offered to graduate students which is designed to afford training in the appropriate methods of investigation and to give familiarity with the fundamental sources of information. Other courses in this field open to graduates cover the more important economic aspects of both public and private finance.

In statistics and social science, work is offered mainly in statistics, but to some degree also in the less definite field of social science. The statistical method has been found of special service both in developing a scientific and judicial attitude and in bringing out many facts about social life not discoverable in any other way. After the introductory course in social science, an advanced course is open which deals with the dependent or semi-dependent classes and

the care for them exercised by society, in part through governmental agencies and in part through private philanthropy.

The courses in politics are designed to familiarize the student with the structure and functions of government, state, national, and municipal. In the advanced courses, special problems are studied. In 1915-1916 in the seminary in public law a study of the police power was made. In the course in research each student is allowed to follow up an investigation of the sources of some particular subject. Students desiring to specialize in Politics should take, as a foundation, the courses on American Political Institutions and Comparative Politics. Courses on Business Law, and on Government Control of Industry cannot be regarded as constituting graduate work.

This group uses two laboratories and several class rooms in proximity to each other and to the four division offices and one general office, an arrangement which has greatly facilitated intercourse between teachers and graduate students as well as among graduate students themselves. In the political science seminary room at the University Library, and in the various offices and laboratories occupied by these departments, numerous publications in politics and in economics are accessible to advanced students. The laboratories for classes in statistics and finance are supplied with standard and current books dealing with these subjects and with various mechanical devices for simple statistical processes and for securing a graphic and effective presentation of results.

In the closely related subject of rural economy or agricultural economics, courses are offered dealing with the general economic and social problems of the open country arising from the growing complexity and intensity of agriculture and its relation with commerce, manufacturing, and transportation.

Several teaching assistantships yielding \$500 and tuition; three fellowships, two yielding \$400 and tuition, and one yielding \$500 and tuition; and several assistantships, each yielding \$250, are filled each spring.

Elementary Social Science. Professor WILLCOX.

Demography or Population Statistics. Professor WILLCOX.

Economic and Industrial Statistics. Professor WILLCOX.

The Dependent Classes. Professor WILLCOX.

Principles of Economics. Professor JOHNSON.

Value and Distribution. Professor JOHNSON.

The Labor Problem. Professor JOHNSON.

Socialism. Professor JOHNSON.

Money and Banking. Professor YOUNG.

Corporations and Trusts. Professor YOUNG.

Railway Transportation. Professor YOUNG.

Municipal Administration. Professor ORTH.

State Administration. Professor ORTH.

Elements of Business Law. Professor ORTH.

Government Control of Industry. Professor ORTH.

American Party System. Professor ORTH.

Constitutional Government. Professor ORTH.

Accounting. Assistant Professor ENGLISH.

Accounting Practice and Problems. Assistant Professor ENGLISH.

American Political Institutions. Professor ORTH and Assistant Professor SABY.

Comparative Politics. Professor ORTH and Assistant Professor SABY.

International Law. President SCHURMAN and Assistant Professor SABY.

History of Political Thought. Assistant Professor SABY.

Modern Political Thought. Assistant Professor SABY.

Problems in Market Distribution. Assistant Professor TURNER.

The Industrial Revolution in England. Assistant Professor USHER.

Social and Economic Problems of the 19th Century in England. Assistant Professor USHER.

Mathematical Economics. Professor YOUNG.

Research in Statistics. Professor WILLCOX.

Research in Finance. Professor YOUNG.

Research in Politics. Professor ORTH.

Seminary in Politics and Public Law. Professor ORTH.

Research in Accounting. Assistant Professor ENGLISH.

General Seminary. Attended by all teachers in political science and all graduate students with majors in that field.

Rural Economy. Professor LAUMAN. See Rural Economy (page 55), and also in the Announcement of the College of Agriculture.

MATHEMATICS

Professors: JAMES McMAHON; J. H. TANNER; J. I. HUTCHINSON; VIRGIL SNYDER; F. R. SHARPE; W. B. CARVER; ARTHUR RANUM; D. C. GILLESPIE; W. A. HURWITZ; C. F. CRAIG; F. W. OWENS.

Instructors: J. V. MCKELVEY; L. L. SILVERMAN; R. W. BURGESS; H. BETZ; M. G. GABA.

The graduate work provides instruction in the principal branches of mathematics and furnishes preparation and material for independent investigation. Only a portion of the whole field can be covered by the courses given in a single year. The courses are, therefore, changed from year to year in order to meet the needs of the students.

In addition to the regular instruction, individual guidance and advice are offered to any student who wishes to follow a particular line of inquiry.

The equipment in mathematics consists of a collection of about three hundred models, including plaster models of the quadric and cubic surfaces, of several forms of the Kummer surface, of the cyclides, of surfaces of centers of quadrics, and of minimum surfaces; plaster models illustrating positive, negative, and parabolic curvature, and constant measure of curvature; plaster models illustrating the theory of functions, among them models of simply and multiply connected surfaces, and of several forms of Riemann's surfaces, and models representing the real parts of algebraic, exponential, logarithmic, and elliptic functions; wooden and glass models of crystals and polyhedra; wire and thread models of twisted curves and ruled surfaces, and skeleton frames for minimum surfaces.

The University Library has a large collection of books on pure and applied mathematics, including collected works of mathematicians, complete sets of all the important mathematical journals, transactions, and other publications of

scientific societies, and doctoral theses from the leading American and European universities.

The Oliver Mathematical Club, composed of teachers and advanced students, meets weekly, and has for its object the systematic presentation, by the members of some specified mathematical theory of recent development, and of reports on noteworthy articles in current journals and on the results of special reading and investigation.

Solid Geometry; Advanced Algebra; Trigonometry; Analytic Geometry; Differential Calculus; Integral Calculus.

Descriptive Geometry. Professor SNYDER.

Projective Geometry. Dr. GABA.

Graphical Methods. Mr. BETZ.

Probabilities and Insurance. Professor MCMAHON.

Differential Equations. Professor OWENS.

Modern Algebra. Professor RANUM.

Advanced Calculus. Dr. McKELVEY.

Finite Differences. D. BURGESS.

Elementary Analysis. Dr. BURGESS.

Elementary Course in Higher Mathematics. Selected members of the staff.

Advanced Analytic Geometry. Dr. SILVERMAN.

Theory of Numbers. Professor CARVER.

Differential Geometry. Professor CARVER.

Theory of Functions of a Complex Variable. Professor CRAIG.

Potential Theory and Fourier Series. Professor SHARPE.

Principles of Mechanics. Professor GILLESPIE.

Theory of Functions of Real Variables. Professor HURWITZ.

Algebraic Geometry. Professor SNYDER.

Mathematical Physics. Professor OWENS.

Students who take mathematics as a major subject for an advanced degree must have completed the equivalent of the elementary course in analytic geometry and calculus, and some further study in at least one somewhat more advanced subject, as for example, differential equations, advanced calculus, modern algebra, or projective or analytic geometry, before residence towards an advanced degree can be recommended.

PHYSICS

Professors: E. L. NICHOLS; G. S. MOLER; ERNEST MERRITT; FREDERICK BEDELL; J. E. TREVOR; J. S. SHEARER; ERNEST BLAKER; F. K. RICHMYER; R. C. GIBBS.

Instructors: R. C. RODGERS; C. C. MURDOCK; E. C. MAYER; T. B. BROWN; R. W. KING; K. S. GIBSON; R. BOWN; W. S. MALLORY; C. L. SWISHER; P. T. WEEKS; H. A. PIDGEON; F. E. E. GERMANN; C. C. BIDWELL; J. C. SCHELLENG.

Opportunities are offered for study and investigation in the various branches of the science, both theoretical and experimental. Some of these opportunities are indicated in the following statement; more complete information can be

obtained by those interested through correspondence addressed to the Department of Physics or to individual members of the staff.

The facilities for radiometric and spectrophotometric work, for the investigation of the properties of matter throughout a very wide range of temperatures, for the study of Roentgen rays and allied phenomena, in electricity, especially for the study of alternating current phenomena, in the application of photographic methods to problems in experimental physics, etc., are exceptionally good.

Forty rooms in Rockefeller Hall are set aside for advanced workers. Research is organized as a distinct division with its own equipment, stock, and apparatus room, well equipped workshop for the use of graduate students, complete appliances for the production and handling of gases, including generators, low and high pressure storage tanks, compressors, power driven vacuum pumps, machinery for the liquifaction of air and other gases, an unusually complete and high powered apparatus for X-rays, a refrigerating plant, a dynamo laboratory, fully equipped with various sorts of direct and alternating current apparatus, oscillograph, etc. An instrument maker's shop with two mechanics is devoted solely to the construction and repair of apparatus.

During the year 1916-17, Professor NICHOLS will direct the work of graduate students in experimental physics and particularly in radiation and luminescence; Professor MERRITT, in theoretical and experimental physics, particularly in electricity and magnetism and problems connected with luminescence; Professor BEDELL, in applied electricity, theoretical and experimental, and particularly in alternating-current phenomena; Professor SHEARER, in theoretical and experimental physics, and particularly in X-rays, in radio-activity, and in work requiring the production and measurement of high and low temperatures; Professor TREVOR, in the theory of thermodynamics; Professor MOLER, in the design and construction of research apparatus and in work involving the use of photography; Professor BLAKER, in sound and light, Professor RICHTMYER, in photometry, illumination, and photo-electricity; Professor GIBBS in absorption spectra and radiation.

Students desiring to undertake graduate work as candidates for a degree should have completed at least two years of undergraduate work in physics, i. e., the equivalent of course 12 (Physics) in the Announcement of the College of Arts and Sciences and its prerequisites.

Introductory Courses.—First Year Physics (experimental lectures, class work, laboratory); Second Year Physics (class work, laboratory); Electrical Measurements; Photometry and Illumination; Practical Photography; X-Ray Photography; Physics for Teachers.

Advanced Courses.

Heat. Assistant Professor BLAKER.

Light. Assistant Professor BLAKER.

Electricity and Magnetism. Assistant Professor BLAKER.

Properties of Matter. Assistant Professor BLAKER.

Sound. Assistant Professor BLAKER.

Advanced Laboratory Practice. Assistant Professor BLAKER.

Advanced Photography. Professor MOLER.

Alternating Currents. Professor BEDELL.
 Electrical Laboratory Practice. Professor BEDELL.
 Advanced Course in Electrical Laboratory. Professor BEDELL.
 Design and Construction of Apparatus for Research. Professor MOLER.
 Conduction in Gases. Professor MERRITT.
 Electric Waves. Professor MERRITT.
 History of Physics in the 19th Century. Professor NICHOLS.
 Fluorescence and Phosphorescence. Professor NICHOLS.
 Photometry and the Physics of Illumination. Professor NICHOLS.
 Photometry and Illumination. Assistant Professor RICHTMYER.
 Spectrophotometry. Assistant Professor RICHTMYER.
 Theory of Light. Assistant Professor BLAKER.
 Theory of Heat. Professor SHEARER.
 X-Rays and Radioactivity. Professor SHEARER.
 Reading Course on the Electromagnetic Wave Theory. Professor SHEARER.
 The Application of Mathematics to Physics. Professor SHEARER.
 Physical Seminary. Professor NICHOLS.
 Theoretical Physics. Mechanics and Thermodynamics. Professor MERRITT.
 Theoretical Physics. Electricity and Magnetism. Professor MERRITT.
 Thermodynamics. Professor TREVOR.

CHEMISTRY

Professors: L. M. DENNIS, Inorganic Chemistry; W. R. ORNDORFF, Organic and Physiological Chemistry; W. D. BANCROFT, Physical Chemistry; E. M. CHAMOT, Chemical Microscopy and Sanitary Chemistry; G. W. CAVANAUGH, Agricultural Chemistry; A. W. BROWNE, Inorganic and Analytical Chemistry; L. J. CROSS, Agricultural Chemistry; G. E. F. LUNDELL, Analytical Chemistry; R. P. ANDERSON, Analytical Chemistry; T. R. BRIGGS, Physical Chemistry; F. E. RICE, Agricultural Chemistry.

Instructors: T. W. B. WELSH; S. A. MAHOOD; F. R. GEORGIA; F. H. RHODES.

A graduate student who desires to take either a major or a minor subject in chemistry may select any one of the following seven branches: inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, sanitary chemistry, chemical microscopy, agricultural chemistry. Under the present procedure, both the major subject and the one minor subject required for the degree of Master of Arts, and the major subject and the two minor subjects required for the degree of Doctor of Philosophy may be selected from the seven divisions mentioned above; but it is desirable that candidates for the degree of Doctor of Philosophy select at least one minor subject outside of chemistry.

A graduate student who desires to take a minor subject in chemistry with some subject other than chemistry as the major subject, will be required to offer introductory inorganic chemistry and elementary qualitative and quantitative analysis as preliminary to his graduate work. The work upon his minor subject in chemistry may be taken in any branch of the subject that he is qualified to pursue, and may comprise advanced courses selected from the subjoined list, with the approval of his special committee.

Candidates for the degree of Master of Arts, or that of Doctor of Philosophy, with the major subject in chemistry will be expected to have a reading

knowledge of French and German, and will be required to offer as preliminary to their graduate work in chemistry the following subjects: introductory inorganic chemistry, elementary qualitative and quantitative analysis, advanced quantitative analysis, and elementary opticochemical methods, gas analysis, organic chemistry, elementary chemical microscopy, and physical chemistry. Courses in these subjects, if taken in another university, will be accepted if they are substantially equivalent to the courses offered at Cornell. Graduate students entering from other universities may take during their residence for the advanced degree such of the above courses as they have not already pursued. If a graduate student lacks at entrance several of these preliminary courses, more than the minimum period of residence, may be necessary. More advanced courses may be elected from the appended list with the approval of a candidate's special committee.

Detailed information concerning the chemical laboratory and its equipment is contained in the Announcement of the Department of Chemistry, which may be obtained on application to the Department. The equipment of the Department for the instruction of the graduate as well as the undergraduate student is unusually complete and there are excellent opportunities for research in each of the various lines of instruction.

Introductory Inorganic Chemistry; Qualitative and Quantitative Analysis.

Inorganic Chemistry

Advanced Inorganic Chemistry. Lectures and laboratory. Professors DENNIS and BROWNE.

Selected Topics in Advanced Inorganic Chemistry. Lectures. Professor BROWNE and Dr. WELSH.

Chemistry of Gases. Lectures. Assistant Professor ANDERSON.

Analytical Chemistry

Advanced Qualitative Analysis. Laboratory. Dr. RHODES.

Advanced Quantitative Analysis. Lectures and laboratory. Assistant Professor LUNDELL.

Electrochemical Analysis. Laboratory. Assistant Professor LUNDELL.

Assaying. Lectures and laboratory. Assistant Professor LUNDELL.

Opticochemical Methods. Lectures and laboratory. Assistant Professor ANDERSON.

Advanced Opticochemical Methods. Laboratory. Assistant Professor ANDERSON.

Gas Analysis. Lectures and laboratory. Assistant Professor ANDERSON.

Advanced Gas Analysis. Laboratory. Assistant Professor ANDERSON.

For courses in Microscopic Chemical Analysis, see Chemical Microscopy.

Organic Chemistry

Organic Chemistry. Lectures and laboratory. Professor ORNDORFF and Mr. MAHOOD.

Special Chapters in Organic Chemistry. Lectures. Professor ORNDORFF.

Advanced Organic Chemistry. Laboratory. Professor ORNDORFF and Mr. MAHOOD.

The Coal Tar Dyestuffs. Lectures and laboratory. Professor ORNDORFF and Mr. MAHOOD.

Stereochemistry. Lectures. Professor ORNDORFF.

Organic Analysis. Laboratory. Professor ORNDORFF and Mr. MAHOOD.

Physical Chemistry

Physical Chemistry. Lectures and laboratory. Assistant Professor BRIGGS.

Advanced Physical Chemistry. Lectures. Professor BANCROFT.

Applied Colloid Chemistry. Lectures. Professor BANCROFT.

Theoretical Electrochemistry. Lectures. Professor BANCROFT.

Applied Electrochemistry. Lectures and laboratory. Assistant Professor BRIGGS.

Advanced Physical Chemistry. Laboratory. Professor BANCROFT and Assistant Professor BRIGGS.

Advanced Electrochemistry. Laboratory. Professor BANCROFT and Assistant Professor BRIGGS.

Sanitary Chemistry

Sanitary Chemistry. Lectures and laboratory. Professor CHAMOT and Mr. GEORGIA.

Special Topics in Food Examination. Lectures. Mr. GEORGIA.

Microscopic Examination of Foods. Laboratory. Professor CHAMOT.

Special Topics in Water Examination. Lectures. Professor CHAMOT.

Advanced Sanitary Chemistry. Laboratory. Professor CHAMOT.

Toxicology. Lectures. Professor CHAMOT.

Chemical Microscopy]

Chemical Microscopy. Laboratory, with recitations and demonstrations. Professor CHAMOT.

Advanced Chemical Microscopy. Laboratory. Professor CHAMOT.

Agricultural Chemistry

Agricultural Chemistry. Lectures, recitations, and laboratory practice. Professors CAVANAUGH and CROSS, and Assistant Professor RICE.

Advanced Agricultural Chemistry. Lectures. Professor CROSS.

Agricultural Analysis. Laboratory. Professor CROSS and Assistant Professor RICE.

Advanced Agricultural Analysis. Laboratory. Professors CAVANAUGH and CROSS.

Household Chemistry. Lectures and laboratory. Professor CAVANAUGH and Assistant Professor RICE.

GEOLOGY

Under the general title of geology are included dynamic geology, physical geography, meteorology, mineralogy, crystallography, petrography, paleontology and stratigraphic geology, economic geology.

Professors: HEINRICH RIES, Dynamic and Economic Geology; G. D. HARRIS, Paleontology and Stratigraphic Geology; A. C. GILL, Mineralogy and Petrography; O. D. VON ENGELN, Physical Geography; W. M. WILSON, Meteorology.

Instructors: R. E. SOMERS; J. S. HOOK; E. D. ELSTON; V. E. MONNETT; P. A. VANDER MEULEN.

Dynamic Geology. No special graduate courses are offered in this branch, advanced work either in the field or laboratory being adjusted to the needs of the individual student. One taking a major in this branch of geology, should first have had at least elementary work in the other branches represented in the department.

Physical Geography. The region round about Ithaca abounds in excellent and varied illustrations of physiography and glaciology. For many years the teachers and advanced students of physical geography have been engaged in an investigation of the field problems, and these studies will be continued. In addition to field work, there are excellent facilities for indoor work. The main laboratory is well equipped with topographic maps and photographs; the collection of relief models is notably complete, and there is an experimental laboratory with apparatus and facilities for carrying on a variety of experiments in the development of land forms, etc.

For admission to the advanced courses, it is required that the student have a working knowledge of the fundamental principles of the subject and have completed some reading other than textbooks. These courses are intended to contribute to the training of students for positions in the better grade of secondary and normal schools, in colleges and universities, in the national geological survey, in exploring expeditions, and to afford preparation for research.

A candidate for an advanced degree whose major subject is in physical geography should have completed, during his undergraduate training, elementary university courses in physics (including an advanced course in heat), chemistry, mathematics, and economics, in addition to introductory courses in physical geography and geology.

Meteorology. The U. S. Weather Bureau observatory, which is located on the Campus, affords special opportunity for the study of both theoretical and economic meteorology.

Mineralogy, Crystallography. and Petrography. The laboratory equipment is relatively good as regards petrographic microscopes, apparatus for chemical and physical investigations of rocks, and apparatus for special crystallographic determinations. There are also collections of rocks and study collections of minerals. The largest of the latter includes the Benjamin Silliman, jr., collection.

Special graduate courses in this division are not offered, but advanced work is adapted to the needs of the individual. Two of the elementary courses are, however, so dependent on a rather advanced knowledge of physics or of chemistry, or of both, that they are to be considered as requiring the maturity of graduates, although open also to undergraduates with sufficient preparation. These are the courses in optical determination of minerals and petrography. For graduate work in these subjects a student should have chemistry, including quantitative analysis, and a good knowledge of general physics. For petrography he should have also not less than a year of general geology.

Paleontology and Stratigraphic Geology. The University is so located that excellent exposures of Devonian formations are at its very door, and the typical sections of New York State, which are of fundamental importance in American paleozoic geology, are within short excursion range. The most important of these are the Rochester and Niagara gorges, Trenton Falls, and the Helderberg escarpments, the Chemung Valley, and the coal fields in northern Pennsylvania. Summer field work has been carried on by boat over a still greater range, extending to Plattsburg on the north and to the Carolinas on the south, giving the student at small cost a chance to study a large portion of the geological column at first hand.

Facilities for those prepared to engage in research in paleontology and stratigraphic geology are furnished by summer cruises into the Tertiary areas of the southern states; eleven seasons' work in Louisiana, together with continuous work in oil investigation, two seasons in Arkansas, two in Texas, one in Europe; the results of numerous exchanges; the Newcomb collection (10,000 species) of recent shells; and the exceptional wealth of conchological literature in the geological and the general library. The Bulletin of American Paleontology, the only paleontological journal in the country, is published in the department.

Economic Geology. The work in economic geology is designed to familiarize the student with the origin, occurrence, and distribution of the mineral products of economic value, and also with the practical application of geological principles. The laboratory contains an excellent study collection of economic materials from the United States, Canada, Mexico, and Europe, including ores, fuels, clays, abrasives, building stones, etc.; most of these representing suites of material collected by members of the staff of instruction on geological trips. This collection is supplemented by maps and models. The departmental library contains a number of reports and books on economic geology; and the University Library has a very full set of works covering this special field.

In addition to the collections, the economic geology laboratory has facilities for general work and research on economic materials, the equipment for clay investigation being especially large.

The work of graduate instruction consists in part of lectures and in part of special work arranged to suit the needs of the individual student. Students who are registered for a major subject in economic geology are expected to engage in research, which should preferably be based on field work.

Excursions may readily be taken to the anthracite region of Pennsylvania; to the iron, slate, cement, and talc region near Easton, Pa.; to the magnetite mines of the Adirondacks, etc. Field trips of greater or less length are taken to some of these localities every year.

Elementary Geology, Elementary Physical Geography; Geography of North America; Geography of Europe; Meteorology and Climatology; Elementary Mineralogy; General Lithology; Crystallography; Blowpipe Determination of Minerals; Historic Geology; Economic Geology.

Glaciers and Glaciation. Assistant Professor VON ENGELN, and Mr. ELSTON.
Experimental Physiography. Assistant Professor VON ENGELN.
Seminary in Physiography. Assistant Professor VON ENGELN.

Physiographic Research. Assistant Professor VON ENGELN.
 Mineralogy. Professor GILL and Mr. VANDER MEULEN.
 Crystal Measurement and Drawing. Professor GILL.
 Optical Determination of Minerals. Professor GILL.
 Petrography. Professor GILL.
 Seminary in Mineralogy and Petrography. Professor GILL.
 Advanced or Special Work in Mineralogy and Petrography. Professor GILL.
 Stratigraphic Geology. Professor HARRIS.
 Paleontology. Professor HARRIS.
 Research and Conference. Professor HARRIS and Mr. OLSSON.
 General Economic Geology. Professor RIES and Dr. SOMERS.
 Clay Investigation. Professor RIES and Mr. HOOK.
 Advanced Economic Geology. Professor RIES.
 Economic Geology Seminary. Professor RIES.
 Experimental Economic Geology. Professor RIES and Mr. HOOK.
 Meteorology and Climatology. Professor WILSON.

BOTANY

(In the College of Arts and Sciences)

Professors: G. F. ATKINSON; W. W. ROWLEE.

The laboratories for advanced work and research are well equipped with apparatus and materials such as microscopes, microtomes, ovens, sterilizers, thermostats, water baths, cameras for photographic and photomicrographic work, culture rooms, electric lantern, etc. The laboratories are directly connected with well-stocked greenhouses. These contain a large assortment of exotic plants, which afford material for illustration and comparison, as well as material for investigation. The greenhouses also afford space for experimental work in plant physiology and morphology, and for the growing of plants under observation. There are excellent facilities for field work in the vicinity of the University.

The University Library contains the more important periodicals and complete sets of journals relating to botanical science, and a large collection of special works devoted to the various subdivisions of the science, as morphology, embryology, histology, physiology, mycology, and the different systematic subdivisions. The works most frequently required for reference are kept in the departmental library.

The botanical seminaries offer opportunity for keeping in touch with the current literature of the subject, and of dealing with the theoretical and practical aspects of the various problems under investigation.

As a prerequisite for graduate work in botany, either as a major or as a minor subject, the student should have a thorough knowledge of the fundamental principles of the science. In addition, some prerequisite or supplementary advanced work in morphology, organography, histology, and taxonomy (according to the nature of the subject chosen by the candidate) will be required. When the candidate has not had the desired advanced work, this may be taken either as preliminary to the work of his special investigation, or carried on at the same time as the latter, by registering in such of these courses as the special committee may determine; but none of the courses indicated will be accepted as meeting the requirement for either the major or the minor subject.

General Comparative Morphology of Plants; Elementary Plant Physiology; Special Morphology, Taxonomy, and Ecology of the Higher Plants; Geographical Botany; Organography and Identification of the Higher Plants; Taxonomy and Phylogeny of Angiosperms; Plant Cytology; Comparative Histology of Plants; Dendrology; Xylology; Comparative Morphology and Embryology; Mycology; Taxonomy of the Pteridophytes, Bryophytes, and Algae; Research in Morphology and Embryology; General Taxonomic Survey of the Fungi.

Research in Comparative Morphology, Embryology, and Experimental Morphology. Professor ATKINSON.

Research in Mycology and Plant Pathology. Professor ATKINSON.

Research in Taxonomy and Phylogeny of the Angiosperms. Professor ROWLEE.

Research in Comparative Histology and Cytology. Professor ROWLEE.

Seminary in Morphology, Embryology, Mycology, Physiology, etc. Professor ATKINSON.

Seminary in Comparative Histology and Taxonomy of the Angiosperms. Professor ROWLEE.

BOTANY AND PLANT PHYSIOLOGY

(In the College of Agriculture)

Professors: K. M. WIEGAND; LEWIS KNUDSON; A. J. EAMES; L. W. SHARP; J. R. SCHRAMM.

Instructors: A. R. BECHTEL; J. M. BRANNON; O. F. CURTIS; L. H. MCDANIELS; W. J. ROBBINS; C. C. THOMAS; F. B. WANN.

The laboratories of this department are located in the agronomy building of the College of Agriculture. Those devoted to general botany are supplied with microscopes, herbarium, and preserved material, microtomes, paraffin baths, and other apparatus and material suitable for carrying out research work in taxonomic botany of the higher plants, and in plant histology, cytology and comparative morphology. In connection with research work in general botany, the very rich flora of Ithaca and vicinity makes the location a particularly desirable one. Gardens and greenhouses are also available for the growing of experimental material. The work in plant physiology is conducted in laboratories equipped with special reference to the demands of advanced instruction and research. Supplementary laboratory space is provided in two headhouses and two greenhouses of twenty-five by seventy-five feet each, these especially giving additional accommodation for the experimental work.

The class work in plant physiology is done in one large, well-lighted, ground-floor laboratory, provided with the necessary facilities for the study of the microscopic, the chemical, and the physical aspects of the subject. The necessary microscopic outfits, lockers, and apparatus required in general physiology are available. Accommodations are made for thirty students in a section.

In a corresponding laboratory on the first floor, excellent facilities and equipment are provided for research in plant physiology. The department possesses seven incubators, drying ovens and paraffin oven, all electrically heated and equipped for temperature control. Recording hygrometers and thermometers, balances, microtomes, photomicrographic apparatus, and a considerable number

of other important large pieces of apparatus are included. There is also available a plentiful supply of all small apparatus which may be necessary.

To graduate students in physiology desks are assigned in small adjacent rooms which serve as headquarters for their supplies and records. Special effort has been made to give opportunities for individual investigation, particularly in such phases of the work as nutrition, respiration, the relation of plants to climatological, and other factors of the environment, the physiology of fermentation, effects of external agencies in heredity, and cell physiology.

The University Library is well equipped with special works and periodicals dealing with all phases of botanical science. A department library in which are kept books that are in frequent use has been established in connection with the laboratories.

A seminary in general botany, histology, cytology and comparative morphology is conducted in which recent literature and special phases of botanical science are taken up for special discussion. The purpose of this seminary is not only to keep abreast of the literature of the subject, but also to furnish to the student an opportunity for the discussion of special phases of his own research. All graduate students except those in plant physiology are required to take part in this seminary.

A corresponding seminary in plant physiology offers to graduate students an opportunity to become familiar with current work in plant physiology, and to consider the relations of this work to agricultural practices. At these meetings there are also held general conferences and discussions of opinions or methods not conveniently or appropriately dealt with in the general courses. All graduate students in plant physiology are required to take part in the work of this seminary, and to gain experience in presenting the results of their own research, or in developing opinions respecting the work of others.

As a prerequisite for work in general botany, histology, cytology and comparative morphology, the student will be expected to have a knowledge of fundamental features of botanical science. A student whose major subject is in this field will be expected to have had advanced courses in general botany, plant histology, cytology and comparative morphology, depending upon the special field in which his work lies. If the advanced courses have not already been taken by a student who elects a minor in this department, he will be expected to take these during his work, and they may count in part toward the work which he offers for his degree.

In order to pursue graduate work in plant physiology, students must have had good scientific preparation. Special training in general biology, botany, and chemistry is essential. In no case, however, may a graduate student enter upon topical work or research without the equivalent of eight hours advanced work in courses in the subject. Special training in certain aspects of horticultural or agronomic work is also recognized as satisfying a general standard of scientific preparation.

General Elementary Botany; Forest Botany; General Plant Physiology.

Histology. Assistant Professor EAMES and Mr. McDANIELS.

Cytology. Assistant Professor SHARP.

Comparative Morphology of Bryophytes, Pteridophytes and Spermatophytes.

Assistant Professor SHARP.

Morphology of the Algae. Assistant Professor SCHRAMM.

Research in General Botany, Histology, Cytology, Taxonomy, and Physiology of the Algae. Profesor WIEGAND, and Assistant Professors EAMES, SHARP and SCHRAMM.

Seminary in General Botany, Histology, Cytology, and Taxonomy. Professor WIEGAND.

Physiology of Fermentation. Assistant Professor KNUDSON and Dr. ROBBINS.

Advanced Plant Physiology. Assistant Professor KNUDSON, Dr. ROBBINS and Mr. CURTIS.

Special Chapters in Metabolism. Assistant Professor KNUDSON.

Research in Plant Physiology. Assistant Professor KNUDSON.

Seminary in Plant Physiology. Assistant Professor KNUDSON.

PLANT BREEDING

Professors: R. A. EMERSON; A. W. GILBERT; H. H. LOVE; C. H. MYERS; E. E. BARKER.

Instructors: A. C. FRASER.

The laboratories of this department are supplied with calculating machines necessary for statistical investigations; have the necessary microscopes, microtomes, paraffin ovens, etc., for studies of the histological phases of genetic problems; and are equipped with cameras and accessories for photographic work. The departmental library contains the principal books and periodicals dealing with plant breeding and general genetics. An extensive card catalogue of genetic literature is an important part of the equipment. The department has greenhouse room approximating 2000 square feet of floor space, a part of which is available for the use of graduate students. These houses are divided into compartments in which can be maintained temperatures suitable for diverse types of plants, and are equipped with the necessary appliances for the care of plant cultures on a small scale. A garden near the laboratories affords the necessary room for most of the plant material used by graduate students. For more extensive plantings, room is provided on one of the University farms.

In order to enter upon graduate work in plant breeding, the student should have had the equivalent of the following courses: genetics, methods of plant breeding, general botany, general plant physiology, elementary zoology or biology, introductory inorganic chemistry, and elementary organic chemistry. In case a student has not had all of these elementary courses, he must take them early in the period of his graduate study, and since he will not be permitted to present them as partial fulfilment of the requirements for a major or a minor in plant breeding, he will ordinarily find it impossible to complete his graduate work in the minimum time.

In addition to the prerequisites listed above, it is highly desirable that upon entering his graduate work the student should have had the equivalent of the following courses: plant taxonomy, plant cytology, advanced plant physiology, plant pathology, trigonometry, and courses in either farm crops, pomology, floriculture, or vegetable gardening. Students who have not had these additional

courses or their equivalents may be allowed to take certain of them as partial fulfillment of the requirements for a major or a minor in plant breeding.

No graduate student may take more than his major or more than one of his minors in this department. All graduate students in plant breeding are required to take the courses in biometry, advanced plant breeding, and evolution, given in this department; to attend the seminary throughout the entire period of their residence; to carry out satisfactorily a course of systematic reading; and to complete such other assignments as may be made by the departmental staff in individual cases. In addition to the above, all graduate students, except those taking a minor for the Master's degree, will be required to complete creditably some problem in genetic research.

Students majoring in plant breeding will find it necessary to remain in Ithaca during the summer, or to make satisfactory arrangements for growing and studying elsewhere the plant materials used in connection with their research problems. Since the department has accommodations for only a limited number, prospective students will find it to their advantage to correspond with a member of the departmental staff some months prior to entering upon their work.

Genetics, Plant Breeding; General Plant Breeding; Methods of Plant Breeding.

Biometry. Professor LOVE.

Advanced Plant Breeding. Assistant Professor BARKER.

Evolution. Assistant Professor BARKER.

Research. Professors EMERSON, GILBERT, LOVE, MYERS; and Assistant Professor BARKER.

Seminary. Professors EMERSON, GILBERT, LOVE, MYERS, and Assistant Professor BARKER.

PLANT PATHOLOGY

Professors: H. H. WHETZEL; DONALD REDDICK; M. F. BARRUS; H. M. FITZPATRICK; V. B. STEWART; C. T. GREGORY; L. R. HESLER; W. H. RANKIN; F. M. BLODGETT.

Instructors: R. J. HASKELL; C. CHUPP; J. L. WEIMER; L. M. MASSEY.

There is a full equipment of apparatus for pursuing graduate work and research in this subject. The equipment includes specially constructed furniture and the most modern types of microscopes, microtomes, sterilizers, electric incubators, and paraffin bath for the work of teaching and investigation. The phytopathological herbarium includes, besides a local collection, complete sets of a number of the well known exsiccati such as Rabenhorst, Roumeguère, Ravanel, Seymour & Earle, Fungi Columbiana, etc. Considerable space in the greenhouses is devoted entirely to graduate work and research. The departmental library includes most of the important works on plant pathology, complete sets of the more important journals, and many monographs. The general library contains a fairly complete collection of mycological books.

During the growing season, the department maintains a number of field laboratories in the more important fruit and crop sections of the State, where members of the staff and graduate students may carry on their investigations.

Each of these field laboratories has a complete equipment of apparatus, meteorological and other instruments necessary, for the most careful research. Candidates for the Doctor's degree are required to spend at least one season in one of the field laboratories, in order that they may come in direct contact with the conditions and the practical aspects of control problems.

Industrial fellowships, established by growers or commercial concerns, are open to award from time to time. These provide exceptional opportunities for investigation, during a continuous period, of problems of great economic importance and scientific value. These fellowships, which are worth from \$500 to \$1000 a year, usually extend over a period of two years, and carry with them sums ranging from \$250 to \$500 to provide for travelling and living expenses, etc., in connection with the work in the field. These are known as temporary industrial fellowships.

Students preparing for graduate work in Plant Pathology are urged to obtain a thorough knowledge of elementary Physics and Chemistry, including Organic and Physical Chemistry, and of General Botany and Plant Physiology. Latin, German, and French are indispensable in phytopathological research, and if possible, the student should have a reading knowledge of these languages before entering upon graduate work. Candidates for advanced degrees must present evidence of fundamental training in all these subjects. Opportunity is afforded for further study in these lines after entering the Graduate School, but under such circumstances, the candidate cannot expect to receive a degree in the minimum time of residence.

Plant Pathology; Principles of the Control of Plant Diseases; Timber Decay and its Prevention.

Advanced Plant Pathology. Professors WHETZEL and FITZPATRICK, and Assistant Professor STEWART.

Mycology (Elementary). Professor WHETZEL and Assistant Professors FITZPATRICK and HESLER.

Mycology (Advanced). Assistant Professor FITZPATRICK.

Phytopathological Histology. Professor WHETZEL.

Bacterial Diseases of Plants. Assistant Professor FITZPATRICK.

Research. Professors WHETZEL, REDDICK, and BARRUS, and Assistant Professors FITZPATRICK, STEWART, GREGORY, RANKIN, HESLER, and BLODGETT.

Seminary.

POMOLOGY

Professors: W. H. CHANDLER; H. B. KNAPP.

Instructors: E. L. OVERHOLSER; A. J. HEINICKE; G. W. PECK.

In addition to the laboratory equipment, there is a fifty-acre field laboratory devoted to commercial and varietal orchards of the different fruits. A special effort has been made to secure in this collection representative varieties of all domesticated species.

Each year a large collection of fruit available for graduate use is brought together at the college. Laboratory equipment is secured as needed for any student carrying on major or minor work in this field as a candidate for the degree of Doctor of Philosophy.

Graduates of Cornell University must offer the following courses as prerequisites for graduate work in pomology: botany 1 and 20, entomology 3, plant pathology 1, chemistry 1 and 30, or 32, and pomology 1. These courses are outlined in the Announcements of the College of Agriculture and of the College of Arts and Sciences. Graduates from universities other than Cornell must offer the equivalent of the above prerequisites. In addition, students are required as a part of their graduate work in pomology to take advanced courses in plant physiology, unless a minor is chosen in that subject. They are urged, however, to choose a minor in some phase of botany, particularly plant physiology. A list of the courses that will be given by this department during the summer term of 1916 will be furnished on application.

On account of the nature of the work, it is very desirable that graduates studying for the Master's degree should spend one summer at Ithaca or in the field, investigating their special subject. This is required of graduates working for the Doctor's degree.

Pomology; Laboratory Course.

Varieties, Judging and Packing. Messrs. OVERHOLSER and HEINICKE.

Systematic Pomology. Messrs. OVERHOLSER and HEINICKE.

Experimental Pomology. Professor CHANDLER.

Advanced Laboratory. Professor CHANDLER, and Messrs. OVERHOLSER and HEINICKE.

Research. Professor CHANDLER, Assistant Professor KNAPP, and Messrs. OVERHOLSER, HEINICKE, and PECK.

Seminary. Professor CHANDLER, Assistant Professor KNAPP, and Messrs. OVERHOLSER, HEINICKE, and PECK.

FLORICULTURE

Professors: E. A. WHITE; A. C. BEAL; DAVID LUMSDEN.

Instructors: A. C. HOTTES; Miss L. A. MINNS; C. L. THAYER; E. C. VOLZ.

Comparatively little research has been done in floriculture. The field is a broad one, and there are excellent opportunities for original work in this subject. Studies in variation, nutrition, or in regard to the culture and improvement of plants may be undertaken. Monographic studies on the various genera of ornamentals offer an important field of study. Summer work is of special importance in studying flower crops, and it is desirable that candidates for the Master's degree spend at least one summer at the University. This is required of all candidates for the Doctor's degree.

Every candidate for an advanced degree in floriculture must have had a thorough training in general biology, botany, economic entomology, soils, fertilizers, and genetics. A student who takes his major subject in this department must already have had the courses noted below or their equivalent, excepting only the advanced courses. A student who takes his minor subject for the Master's degree in this department may register for these courses. All candidates must submit a typewritten, bound thesis, a copy of which shall be left with the department.

In addition to the classroom and laboratory equipment, a new range of greenhouses, aggregating sixteen thousand square feet of glass, is now available for instructional purposes. The department has about thirty acres of land devoted to field experiments with peonies, gladioli, lilies, roses, asters and other annual and perennial plants. This area also furnishes material for laboratory exercises.

The library equipment consists of a large and steadily increasing collection of works of reference, comprising a number of the rarer books of the ancients, an unusually full assortment of the garden herbals of the sixteenth, seventeenth, and eighteenth centuries, and the leading monographs and manuals of modern times, supplemented by complete sets of a large number of the horticultural journals of Europe and America. This large collection has also been supplemented by the gift of the extensive private library of the late Professor John Craig. The largest bound collection of seed, plant, and nursery catalogues in the United States is in the library of the department. This collection is very useful to students monographing horticultural plants. Students have access to an herbarium comprising about thirteen thousand cultivated plants.

Principles and Methods of Greenhouse Practice. Professor WHITE and Assistant Professor LUMSDEN.

Greenhouse Construction. Assistant Professor LUMSDEN and Mr. THAYER.

Commercial Floriculture. Professor WHITE and Assistant Professor LUMSDEN.

Greenhouse and Garden Practice. Mr. VOLZ.

Floral Arrangement. Professor WHITE, Mr. THAYER, and Miss MINNS.

Conservatory Plants. Professor WHITE, and Mr. THAYER.

Garden Flowers. Assistant Professor LUMSDEN, Mr. HOTTES, and Miss MINNS.

Amateur Floriculture. Miss MINNS.

Wholesaling and Retailing Flowers. Professor WHITE.

Advanced Courses—History and Literature of Floriculture. Professor BEAL.

Investigation in Floriculture. Professors WHITE and BEAL.

Seminary. Professor WHITE and staff.

ZOOLOGY

Professors: H. D. REED; A. H. WRIGHT; A. A. ALLEN.

Opportunity is offered for investigation in general zoology, systematic zoology, comparative anatomy, ecology, and ornithology.

The museum contains representative forms of the various animal groups. In its formation, efforts have been made to obtain material from all parts of the world illustrating biologic and evolutionary ideas. Most of the families of animals are represented in the collection, and, in some of the major groups, most of the genera.

The large fauna of the Cayuga Lake basin, with its admixture of the Transitional, Canadian, and Upper Austral life zones and with its diverse topographic conditions, affords unusual opportunities for advanced work and research in ecology.

Every facility possible in the way of material and apparatus is placed at the disposal of students desiring to work in the above fields.

Aside from the elementary courses mentioned below, a student should have had courses in histology and embryology. For investigation in ecology, a knowledge of the fundamentals of physics, chemistry, geology, and physiology is necessary.

Elementary Zoology; Mammalian Anatomy based upon a study of the cat; Comparative Anatomy; Systematic Zoology and Ecology. (These courses or their equivalents are prerequisite to graduate work.)

Comparative Morphology and Evolution of Vertebrates. Assistant Professor REED.

Ichthyology, Herpetology, Mammalogy. Assistant Professor WRIGHT.

Economic Ornithology, Systematic Ornithology. Assistant Professor ALLEN.

ENTOMOLOGY, LIMNOLOGY, AND NATURE-STUDY

Professors: J. G. NEEDHAM, Entomology and Limnology; W. A. RILEY, Morphological Entomology; O. A. JOHANNSEN, G. W. HERRICK, C. R. CROSBY, R. MATHESON, Economic Entomology; J. C. BRADLEY, Systematic Entomology; G. C. EMBODY, Aquiculture; E. R. KING, Apiculture; Mrs. A. B. COMSTOCK, Nature-Study.

Instructors: MISS A. C. STRYKE; C. H. HADLEY, JR.; J. T. LLOYD; C. P. ALEXANDER; W. L. CHANDLER.

Students are offered opportunity for advanced work in one or more of the following subjects: insect ecology, morphology of insects, embryology of insects, systematic entomology, economic entomology, limnology, aquiculture, and nature-study.

Each of the laboratories is well supplied with microscopes and other apparatus necessary for the special work carried on in it. The laboratory of morphology and embryology is especially equipped for histological work. Connected with the laboratory of systematic entomology are extensive collections of both North American and exotic insects of all orders. These have been determined by specialists and are accessible to properly prepared students for comparison. The collection includes many sets of specimens illustrative of the metamorphoses and habits of insects. There is also in the museum a good series of invertebrates other than insects, and there are many types. The advanced work in economic entomology is carried on in large part in an insectary, a separate building; a second insectary adjacent to the laboratories is available for other phases of the work. A biological field station at the head of Cayuga Lake, one mile from the Campus and open throughout the year, and a hatching station in Cascadilla Gorge on the Campus afford exceptional opportunities for investigations in the biology of fresh water organisms.

The special library is rich in works on entomology and contains complete sets of all the more important entomological journals.

General Biology; General Entomology; Ecology of Insects; Elementary Morphology of Insects; Elementary Systematic Entomology; Entomotaxy; Apiculture.

The courses above, except apiculture, or their equivalents, are prerequisite to graduate study in entomology.

Systematic Entomology

Research in Systematic Entomology. Assistant Professor BRADLEY.
Advanced Systematic Entomology. Assistant Professor BRADLEY.
Taxonomy of Insects: a series of courses, running through nine terms, dealing with all the orders of insects in succession. Assistant Professor BRADLEY and Professor JOHANNSEN, assisted by specialists in the several groups.
Classification of the Coccidæ. Assistant Professor BRADLEY.
Entomological Literature and its Technique. Assistant Professor BRADLEY.

Insect Morphology

Research in Morphology of Insects. Professor RILEY.
Morphology and Development of Insects. Professor RILEY.
Histology of Insects. Professor RILEY.
German Entomological Reading. Professor RILEY.
French Entomological Reading. Miss STRYKE.

Parasitology and Medical Entomology

Animal Parasites and Parasitism. Professor RILEY.
The Relations of Insects to Disease. Professor RILEY.
Advanced Work in Parasitology. Professor RILEY.

Economic Entomology

Research in Economic Entomology. Professor HERRICK and Assistant Professor MATHESON.
Economic Entomology and Insectary Methods. Assistant Professor MATHE-
SON.
Forest Insects. Professor HERRICK.
Apiculture. Assistant Professor KING.

Ecology and Limnology

Research in Ecology of Insects. Professor NEEDHAM.
Research in Limnology. Professors NEEDHAM, RILEY, and Assistant Pro-
fessor EMBODY.
General Limnology. Professor NEEDHAM and Mr. LLOYD.
Research in Aquiculture. Assistant Professor EMBODY.
General Aquiculture. Assistant Professor EMBODY.

Miscellaneous

Nature-Study. Assistant Professor COMSTOCK.
Nature-Study Seminary. Professor NEEDHAM and Assistant Professor COM-
STOCK.
Journal Club.
Seminary.

HISTOLOGY AND EMBRYOLOGY

Professor: B. F. KINGSBURY.

Instructor: H. M. KINGERY.

The equipment for this subject comprises a supply of modern microscopes, camera lucidas, polariscopes, microspectroscopes, photomicrographic cameras, and other special apparatus, in sufficient number to give each student opportunity for learning to use them, and for applying them to any special study in which they are needed. Two projection microscopes are available for blotting paper and wax plate reconstructions. The general and research laboratories are large and are equipped with microtomes, incubators, aquaria, etc. The collection of specimens is large and constantly increasing, and comprises preserved material and embryos, as well as embryological and histological series of microscopic preparations of man and mammals and the lower vertebrates.

In addition to the general laboratory, preparation room, and private laboratory rooms for the staff, there are for this subject a large and well lighted advanced laboratory with three small rooms for individual workers, a photomicrographic laboratory and dark room, and a drawing and projection room. A museum of embryological models occupies the center of the advanced laboratory. The rich and varied fauna of the Cayuga Lake region affords favorable opportunity for investigations in the histology and embryology of all the main groups of vertebrates; material for the study of the development of the sheep, cow, and pig, is also available. Advanced work in histology and embryology is of necessity individual and is abundantly provided for. In addition advanced students are sometimes recommended to take some one or more of the general courses in the subject. As preliminary to graduate work, students are expected to have had the courses in the tissues and one of the following: the organs, special histology, embryology, the nervous system and organs of special sense. A year's work in zoology, biology, or physiology may with advantage precede advanced work in this subject.

The Tissues; The Organs; Embryology; The Nervous System and Organs of Special Sense.

Advanced Work in Histology and Embryology. Professor KINGSBURY and instructors.

Seminary in Histology and Embryology.

PHYSIOLOGY AND BIOCHEMISTRY

Professors: SUTHERLAND SIMPSON; MELVIN DRESBACH; J. B. SUMNER.

Instructors: A. T. RASMUSSEN; R. L. HILL.

For advanced and graduate work in experimental physiology two large laboratories and several smaller rooms are available. Laboratory A, on the first floor of Stimson Hall, is provided with electro-motor-driven shafting and Sherrington recording drums of the most recent pattern, capable of giving wide ranges of speed. All necessary apparatus is available for graphic work in muscle and nerve physiology, for the investigation of problems in connection with the circulatory and respiratory systems, where objective records are desirable (for example, movements of the excised amphibian and mammalian heart), and for the experi-

mental study of the special senses and the central nervous system. Pendulum and spring myographs are available and several forms of ergograph for the study of muscular and nervous fatigue. Each table is supplied with chronographs and time-recording tuning-forks, induction machines, keys, switches, commutators, etc. Adjoining this laboratory are two smaller rooms; one is being equipped for experimental work on animal heat and body temperature, the other contains a Ludwig kymograph with accessories, and is used primarily for experimental pharmacology. There is also a dark room for photographic and optical work.

Laboratory B is devoted exclusively to research. The equipment includes hæmomanometers and blood-pressure apparatus of the most recent type, and a large Brodie kymograph for continuous smoked paper. A time-recording clock and artificial respiration and chloroform apparatus have just been added. Plethysmographs for recording volume changes in the various bodily organs are provided, and several clock-driven drums are available.

In connection with this laboratory there is a workshop with a skilled mechanic who is capable of making and modifying any kind of apparatus which may be required for special research.

In the basement, on a solid concrete floor, a room is being equipped with galvanometers, capillary electrometers, shunts, rheocords, bridges, and all the other apparatus required in electrophysiology.

The biochemical laboratories on the second floor of Stimson Hall include a general laboratory, and a smaller laboratory for research, both fitted throughout with water, gas, suction pumps, and draught cupboards. Adjoining these are a room for metabolic work, a balance room, a constant temperature room, and storerooms for chemicals and apparatus.

The equipment, which is being steadily increased along many special lines, is suited to the investigation of problems connected with the chemistry and functions of the animal body, and includes, besides a stock of glass apparatus and the ordinary fittings of a chemical laboratory, several metabolism cages, large and small balances, polarimeter, large centrifuge, Buchner press, incubators, and a selection of the most important works of reference. The principal periodicals dealing with physiology and biochemistry are also kept in the building.

A problem demanding original investigation is prescribed for each student, who is guided in his choice of a subject by one of the professors in charge, due consideration being given to his previous training and to the line of work in which he desires to specialize. Having selected a subject, the student will be expected to concentrate his efforts upon it. While the work is done under the supervision of some one of the members of the teaching staff, and every facility provided in the way of apparatus, etc., the student is encouraged to rely on his own resources as far as possible, especially in planning and carrying out his experiments. Any special apparatus which he may require or which he may himself design, will be made for him by the laboratory mechanic. It is expected that the results of his work will be embodied in a thesis, and if this is judged to be of sufficient merit it will be published in full or in abstract in some accredited scientific journal.

In addition to this specialized work, in order to give breadth of view, a course of reading will be assigned from time to time. This will be supplemented periodically by a colloquium, at which the current literature will be reviewed, and original papers presented for discussion.

Physiology of the Cell, Muscle, Nerve, Heart and Circulation, Blood and Lymph, and Respiration; Physiology of Digestion, Excretion, Internal Secretion, Animal Heat and Reproduction; Elementary Human Physiology; Experimental Physiology; Laboratory Work in Physiology; Elementary Biochemistry; General Biochemistry; Practical Biochemistry.

Physiology of the Nervous System and Special Senses. Professor SIMPSON.
Special Chapters in Biochemistry. Assistant Professor SUMNER.

Advanced Work and Research in Physiology. Professor SIMPSON.

Advanced Work and Research in Biochemistry. Assistant Professor SUMNER.

Seminary in Physiology and Biochemistry. Professors SIMPSON and SUMNER.

ANATOMY

Professor: A. T. KERR.

Instructor: H. K. DAVIS.

The laboratories for this subject are situated on the third floor of Stimson Hall and are admirably lighted and thoroughly ventilated. For gross dissection there is a large general laboratory, and adjoining the dissecting room is a smaller laboratory for special work, fitted with a hood and other facilities for digestion, maceration, and the making of corrosion specimens. At the end of the main dissecting room is another laboratory for topographical and regional dissection; also a large dark room with a projection outfit and facilities for drawing sections for making reconstructions. Upon this floor also is situated a dark room with a complete outfit for taking photographs of special preparations for illustrating research. In the basement is a compressed air apparatus for embalming and making special injections.

There is an abundance of anatomical material, which is embalmed and kept in cold storage so as to be ready for use when needed. The refrigerating apparatus is also used for freezing specimens for sections. In addition to the undissected material, there is an ample supply of special parts, such as bones, brains, the various abdominal and thoracic organs, special sense organs, etc.

The equipment includes dissecting microscopes, glassware, reagents, and other necessities of an anatomical laboratory.

In collaboration with the department of Histology and Embryology, every facility is offered for studying anatomical problems from both the gross and the developmental points of view.

In the library are to be found complete sets of practically all of the important periodicals dealing with anatomy, and the proceedings and transactions of the learned societies. In addition, the library is well supplied with the most important anatomical monographs and books.

Graduate work in anatomy should be preceded by courses in general biology and comparative or human anatomy. A reading knowledge of German and French is essential for successful research in anatomy.

Anatomy; Dissection of the upper extremity; Dissection of the head and neck; Dissection of the thorax; Thoracic and abdominal viscera, section demonstrations; Dissection of the lower extremity; Dissection of the abdominal and pelvic walls and viscera.

Central Nervous System, Gross Anatomy. Laboratory work with occasional demonstrations. Professor KERR and Mr. DAVIS.

Anatomy. Advanced work and research. Professor KERR.

Anatomy of the Live Body. Assistant Professor ———.

Detailed topographical dissection and study of any region. Professor KERR and Mr. DAVIS.

Dissection of the entire human body. Professor KERR and Mr. DAVIS.

Research and Advanced Work. Professor KERR.

COMPARATIVE PATHOLOGY AND BACTERIOLOGY

Professors: V. A. MOORE; S. H. BURNETT; C. P. FITCH; E. M. PICKENS.

The laboratories in comparative pathology and bacteriology are well equipped for research in general pathology, the pathology of infectious diseases, and for bacteriological work, especially in connection with animal bacterial flora, pathogenic organisms, and problems associated with the morphology and physiology of bacteria and their products. The library facilities are good.

Candidates for advanced degrees taking their major subject in pathology or bacteriology should have had courses in general pathology or in bacteriology equivalent to the corresponding courses given in this department. Candidates electing a minor subject in this department may take the courses in general pathology and bacteriology.

General Pathology; Special Pathology; Pathology of Infectious Diseases; Parasites; Laboratory Methods of Diagnosis; Post Mortem Examinations; Meat and Dairy Inspection.

Research in Bacteriology and Pathology. Professors MOORE, BURNETT and FITCH.

Seminary. Professors MOORE, BURNETT, FITCH and PICKENS.

VETERINARY PHYSIOLOGY

Professors: P. A. FISH; C. E. HAYDEN.

The department has a good equipment for the study of physiological problems in connection with the domesticated animals. The laboratories, located in the Veterinary College, are ample and are provided with modern apparatus for such research as can best be conducted in the laboratories. In the same building there is a well assorted collection of recent books and periodicals on comparative physiology, which may be supplemented by the many works on general physiology in the University Library.

The Veterinary Experiment Station, controlled by the College, and not far distant, can be utilized for field observations and the study of those problems outside of the scope of the laboratory. This unusual combination of field and laboratory research should be conducive to important results.

As a preparation and aid in this research, attendance at the general lecture and laboratory courses in veterinary physiology is recommended.

Physiology Recitations; the Physiology of the Nutrition and Secretion of the Domesticated Animals; the Physiology of the Muscular and Nervous Systems; Physiological Laboratory; Course in Urine Analysis.

Advanced Physiology. Professor FISH and Assistant Professor HAYDEN.

VETERINARY SURGERY

Professor: J. N. FROST.

Instructor: J. F. SHIGLEY.

The laboratory in Surgery is well equipped for research and special study along surgical lines, especially in connection with diseases of the bones, tendons and tendon sheaths.

Candidates for advanced degrees should have as preliminary preparation general pathology, physiology, general and special surgery.

Special Surgery. Professor FROST and Dr. SHIGLEY.

Research in Surgical Diseases. Professor FROST and Dr. SHIGLEY.

VETERINARY OBSTETRICS AND RESEARCH IN THE DISEASES OF BREEDING CATTLE

Professor: W. L. WILLIAMS.

The department has available for research in connection with the diseases of breeding cattle a small herd of experiment cattle, with accurate history throughout the lives of the animals. Upon these, research work is constantly being conducted.

The department has also an extensive collection of laboratory material relating to the diseases of the *genital* organs of cattle.

In addition, observations are being conducted in herds at varying distances from the University, in which research students may participate.

Extensive research work upon the diseases of the genital organs of cattle, with special reference to the phenomena of sterility, abortion, and other serious diseases, are being constantly conducted. The bacteriological features of the work are carried out by the Department of Pathology, in conjunction with the clinical studies made in this department.

SOIL TECHNOLOGY

Professors: T. L. LYON; E. O. FIPPIN; J. A. BIZZELL; H. O. BUCKMAN; J. K. WILSON.

Instructor: W. W. WARSAW.

A graduate student who desires to make soil technology his major subject should have had sufficient training in organic or biological chemistry, or in bacteriology, to give him a command of the technique as well as of the principles of the subject. It is also desirable that he should have had enough technical agriculture to enable him to see the agricultural bearing of the work.

The facilities for graduate study in this subject may be divided into two groups: first, those of the research laboratory; and second, those of the teaching laboratory.

The research laboratory is primarily concerned with investigations and is open, except in unusual cases, only to graduate students who are working upon their major subjects.

The laboratory is planned for chemical, bacteriological, and physical investigations of soil. The object has been so to equip it that a soil problem may be attacked through most of the known means of soil study. The usual facilities for the chemical analyses of soils and plants are at hand, and permit the deter-

mination of all of the constituents of the soil concerned in plant nutrition. For bacteriological work the laboratory contains in its equipment an autoclav of the largest size, sterilizers, incubators for different temperatures; and for mechanical analyses a centrifuge, a shaking machine, and other necessary apparatus. Two greenhouses provide opportunity for conducting crop tests of soils during the winter, and for experiments with nutrient solutions and sand cultures. A field for plat experiments gives ample facility for work on a larger scale. In this field a series of large concrete tanks, each holding between three and four tons of soil, has recently been built. Pipes from these tanks carry the drainage water into a tunnel where it is collected for measurement and analysis. These varied and extensive facilities afford opportunity for students trained in any one or more of several sciences to investigate soil or plant nutrition problems.

The general laboratory is equipped with many types of apparatus for soil study, including centrifugal apparatus for mechanical analysis, constant temperature ovens, aspirators, titration apparatus, pressure filter pumps, etc. There are in addition several hundred samples of soil from all parts of the United States for comparison and classification. All the soil maps of the United States arranged in form for ready reference, and all the literature relating to the various phases of soil study to be found in the departmental and University Library collections are available. The laboratories are supplemented by extensive field plats, and the university farm is used for the investigation of many problems which require that type of equipment.

A graduate student who desires to take a minor subject in this department will be expected to take the regular courses offered in the department unless he has already had their equivalent, in which case other work will be given him. (See Announcement of the New York State College of Agriculture.)

Students who are expecting to take graduate work in soil technology are advised to write to some member of the instructing staff for information.

Principles of Soil Management. Professor BIZZELL and Assistant Professor BUCKMAN.

Soil Surveying. Assistant Professor BUCKMAN.

Soils, Advanced Course. Professor BIZZELL.

Drainage and Irrigation. Assistant Professor BUCKMAN.

Mechanical Soil Analysis. Professor BIZZELL.

Research in Soils. Professors LYON and BIZZELL and Assistant Professor BUCKMAN.

Soils Seminary. Professors LYON, FIPPIN, BIZZELL and Assistant Professors BUCKMAN and WILSON.

RURAL ECONOMY

Professor: G. N. LAUMAN.

Instructor: H. D. PHILLIPS.

It is not expected that all students of the subject will have a general knowledge of scientific agriculture in addition to training in economics and history; but for those who expect to specialize in this subject, a knowledge of the technical side of agriculture is strongly recommended. Many problems, however, may be successfully studied without the more technical training.

The library collections, general and departmental, are unusually complete. Much attention has been given to collecting the literature dealing with the economic and social conditions of agriculture in Western Europe. The literature of the technical side of agriculture, containing as it does a wealth of data as yet little used, is available in considerable completeness.

As many non-technical rural problems are best studied by actual contact with the population, the close relations maintained by the College of Agriculture in its extension work may be made an important aid to the student.

Agriculture.

Economic and Social Status of the Rural Community.

Rural Economy.

History of Agriculture.

Marketing and Prices.

Co-operation.

Investigation.

RURAL EDUCATION

Professors: GEO. A. WORKS; F. L. GRIFFIN; E. M. TUTTLE.

Arrangements have been made so that a graduate student who is a candidate for an advanced degree may choose, either as a major or a minor subject, Education and Rural Education, or Rural Economics and Rural Education. Attention is therefore called to the announcement on page 26, of the provision for graduate work in Education, and to that on page 55, regarding graduate work in Rural Economy. Relations with the State Department of Education make available for graduate students in this department the use of certain data collected at Albany.

Training in technical agriculture is not required for all phases of work in Rural Education; but in general such training will be found desirable. Students who propose to undertake graduate studies in this subject are advised to confer or correspond with Professor Works before entering the Graduate School.

Agriculture in the High School; Home Economics in the High School; Principles of Teaching with reference to Vocational Education Teaching.

Investigation. Professor WORKS.

Seminary. Professor WORKS.

FARM CROPS

Professors: E. G. MONTGOMERY; J. H. BARRON.

Instructors: E. V. HARDENBURG; O. W. DYNES.

Before undertaking graduate work in farm crops, the student should have had a general scientific training (six hours in botany, ten hours in chemistry, four hours in geology, and six hours in physics), equivalent to courses in Cornell University, as well as at least five hours of university work in soils and crops.

Cereals, Forage Crops; Potatoes, and Special Crops.

Cereal Crops. Professor MONTGOMERY.

Forage Crops. Professor MONTGOMERY.

Seminary. Professor MONTGOMERY.

Research. Professor MONTGOMERY.

FARM MANAGEMENT

Professors: G. F. WARREN; K. C. LIVERMORE; A. L. THOMPSON; G. P. SCOVILLE.

Instructors: D. S. FOX; E. G. MISNER; L. E. HARVEY; W. I. MYERS; R. F. POLLARD.

Admission as a graduate student does not necessarily admit to graduate work in farm management. For major work, only those persons who have spent several years in farm work, and who have had training in economics and in subjects dealing with the production of crops and animals, will be allowed to take a major in this field of study.

Since the satisfactory completion of an investigation in farm management ordinarily takes more than one year, students who can spend but one year are recommended to take a minor rather than a major in this subject.

Cost Accounting. Assistant Professor THOMPSON.

Farm Management. Professor LIVERMORE, and Assistant Professor THOMPSON.

Advanced Farm Management. Professor LIVERMORE.

Types of Farming in the United States. Professor WARREN.

Agricultural Statistics. Professor WARREN.

Seminary. Professors LIVERMORE and WARREN, and Assistant Professor THOMPSON.

ANIMAL HUSBANDRY

Professors: H. H. WING; M. W. HARPER; E. S. SAVAGE; L. A. MAYNARD.

Instructors: K. J. SEULKE; G. W. TAILBY, JR.; DEVOE MEADE.

Among the herds and flocks belonging to the College of Agriculture may be mentioned the dairy herd of fifty cows, a stud of Percheron horses, a flock of about 150 sheep of various breeds, and a herd of breeding swine. The equipment for animal husbandry includes a very full collection of the herd and flock registries of all the breeds of domestic animals kept in this country, amounting to more than one thousand volumes, and affording excellent facilities for studies in heredity and genetics. Further work may be carried on in problems of animal nutrition based on investigation with the animals themselves.

Animal Husbandry; Meat and Milk Production; Practice in Feeding and Stable Management; The Horse; Mechanics of the Horse; Advanced Stock Judging; Principles and Practice of Feeding; Principles of Animal Breeding; Practical Horse Training; Dairy Cattle; Beef Cattle, Sheep, and Swine.

Advanced Course in the Principles of Breeding Animals. Professors WING and HARPER.

Advanced Course in the Principles of Feeding. Professors WING and SAVAGE.
Mechanics of the Horse. Professor HARPER.

POULTRY HUSBANDRY

Professors: J. E. RICE; E. W. BENJAMIN.

Instructors: O. B. KENT; A. B. DANN; T. B. CHARLES.

The equipment includes over 2500 fowls with which to carry on feeding and breeding experiments, and also appliances for investigation in incubation and brooding. The laboratories contain facilities for anatomical work. In addition to a very complete set of bulletins in the poultry library, assembled from the various Experiment Stations in the United States and Canada, numerous books on poultry husbandry are available in the University Library, the library of the College of Agriculture, and the special departmental library. The department is also provided with a topical card index, with cross references, of the principal poultry books, bulletins, and magazines; a large mass of data from research; 5005 negatives, a large number of which have to do with poultry investigations; and 1494 lantern slides.

The new poultry husbandry building with the new auxiliary buildings are now in use and furnish facilities for graduate work along many lines of instruction and research. These buildings have been constructed at a cost of approximately \$150,000, and include, besides the administration building, the fattening house, breed exhibition house, laying pens, and long brooder house. Forty-three varieties of poultry are available for study and ample facilities are now available for the study of the adaptation of the various breeds, feeds, equipments, methods, etc., to the needs of the various locations and types of poultry farming.

Owing to the fact that many colleges do not give the undergraduate courses in poultry husbandry which are prerequisite to graduate work in the subject, students coming from other colleges cannot in all cases enter immediately upon graduate study. Most students will find it necessary or desirable to spend a year in preliminary study before beginning graduate work.

Courses of instruction of an advanced nature may be taken along the lines of poultry feeding, breeding, marketing, co-operation, refrigeration, advertising, house construction, and poultry farm management; and, in co-operation with the staff of the Veterinary College, in poultry disease investigations; in co-operation with the staff in agricultural chemistry, in incubation and nutrition investigations; and in co-operation with the staff in histology and embryology, in incubation experiments.

Poultry Husbandry, general course; Breeding and Diseases; Feeding Practice; Incubator Practice; Brooder Practice; Breeds and Judging; Poultry House Design and Construction; Poultry for the Household; Market Products; Marketing Practice; Farm Poultry.

Advanced Judging. Mr. KENT.

Poultry Farm Management. Professor RICE, Assistant Professor BENJAMIN and Mr. CHARLES.

Commercial Marketing. Assistant Professor BENJAMIN and Mr. ———.

Poultry Feeds and Feeding. Mr. DANN.

Seminary. Professor RICE, Assistant Professor BENJAMIN, and Messrs. KENT, DANN, and CHARLES.

Research. Professor RICE, Assistant Professor BENJAMIN, and Messrs. KENT, DANN, and CHARLES.

DAIRY INDUSTRY

Professors: W. A. STOCKING; H. E. ROSS; H. C. TROY; E. S. GUTHRIE; W. W. FISK.

Instructors: T. J. MCINERNEY; H. M. PICKERILL; G. C. SUPPLEE; A. M. BESEMER; H. B. ELLENBERGER.

The different laboratories of the department are well equipped with apparatus for special work and offer good opportunities to graduate students for research.

Before taking up graduate work in dairy industry, it is desirable that a student should have chemistry course 6, or its equivalent, and bacteriology course 4, or its equivalent, in addition to the elementary courses in the particular subject in which he wishes to do his graduate work.

A limited number of graduate students intending to fit themselves for teaching dairy industry may have an opportunity for practice in instruction in the different laboratories during the winter courses.

It is expected that graduate students in dairy industry will attend the seminary in that subject.

Milk Composition and Tests; Butter Making; Cheese Making; Elementary Bacteriology; Dairy Mechanics; Market Milk and Milk Inspection; Fancy Cheese Making; Ice Cream; General Agricultural Bacteriology; Bacteriology for the Home.

Advanced Testing. Professor TROY.

Dairy Bacteriology. Professor STOCKING and Mr. PICKERILL.

Advanced Buttermaking. Professor GUTHRIE.

Advanced Cheddar-Cheese Making. Assistant Professor FISK.

Research. Professors STOCKING, ROSS, TROY, GUTHRIE, and Assistant Professor FISK.

Seminary. Professors STOCKING, ROSS, TROY, GUTHRIE, and Assistant Professor FISK.

Research. Professors STOCKING, ROSS, TROY, GUTHRIE, and Assistant Professor FISK.

LANDSCAPE ART

Professors: E. GORTON DAVIS; RALPH W. CURTIS.

Graduate work is offered in landscape design, and town planning, planting design, history of landscape design, and landscape engineering.

Candidates for the degree of Master in Landscape Design must be graduates of colleges of equal standing with the New York State College of Agriculture, and must have completed a course substantially equivalent to that offered by the Department of Landscape Design, and leading to the degree of Bachelor of Science in this College. Students who have been admitted to the Graduate School, but who have not had preparation adequate to qualify them to become candidates for an advanced degree in this field, may be required to parallel their major lines of study in the department with lecture courses that are required by the department for undergraduates. Further, they may be required to amplify their preparation for work in landscape design by the election of undergraduate work in other colleges of the University. When a student has attained such a

status in his work as to be eligible for a master's degree in not more than two years, he may become a candidate for that degree.

This department is well equipped with the conveniences and facilities needed in the prosecution of its work. It is provided with a very complete reference library containing the best and most important literature, both early and modern; many folios of illustrations of noted European and American parks and estates; a collection of several thousand photographs of the best examples of recent landscape work in this and other countries; files of plans and drawings; examples of the technic of drawing and expression; and of the best work of representative practising landscape designers, illustrating their solutions of various types of landscape problems. A large collection of lantern slides supplements all lecture courses, and the same illustrations are accessible for reference in prints catalogued and indexed by subjects. An ample herbarium and a large collection of photographs of plant materials supplement the indoor work in courses in planting design. While the University Campus affords an excellent collection of woody plants in mature condition, an arboretum is rapidly being developed which exhibits all the useful plant forms in arrangement for type study and also in their grouping for various uses.

Advanced work in design and construction is considerably broadened by opportunity for discussion with, and criticism from, well-known visiting lecturers and critics.

Summer work, both graduate or preparatory for graduate work, may be taken in plant design by arrangement with Assistant Professor Curtis during the regular period of instruction in the third term of the College of Agriculture.

The Appreciation of Landscape; History of Landscape Design; Theory and Aesthetics of Landscape Design; Planning of Private Properties; Planning of Public Properties; Elementary Landscape Design; Elements of Planting Design; Landscape Design; Landscape Engineering and Details of Construction; Planting Design; Seminary.

Landscape Design. Professor DAVIS and Assistant Professor CURTIS.

Town Planning. Professor DAVIS.

Planting Design. Assistant Professor CURTIS.

History of Landscape Design. Professor DAVIS.

Seminary. Professor DAVIS and Assistant Professor CURTIS.

FORESTRY

Professors: R. S. HOSMER; S. N. SPRING; A. B. RECKNAGEL; JOHN BENTLEY, JR.
Instructor: C. H. GUISE.

Students who wish to elect a major or a minor subject in forestry, either for a Master's degree or for a Doctor's degree, are offered opportunity for advanced study or research in silviculture, forest management, forest mensuration, and forest policy.

Adequate preparation for the profession of forestry requires at least a year of graduate study in addition to the four year undergraduate course. The undergraduate work in forestry leads to the degree of Bachelor of Science; the graduate work leads to that of Master in Forestry. Candidates for the degree

of Master in Forestry must also have had at least three months' experience in forestry work or in a logging camp, satisfactory proof of which is to be by a signed statement, or an examination in woodmanship, or both. Students who enter as graduates without having had undergraduate instruction in forestry should be able to complete the work for the Master's degree in two years, if they have had substantially the equivalent of most of the courses, other than forestry, listed in the recommended sequence of courses for the first four years of the professional work. If they lack much of the fundamental science work there listed, it will require a correspondingly longer time to get the Master's degree. Certain of the required forestry courses, both graduate and undergraduate, are given only in the third (Summer) term. For 10 weeks instruction is given in a camp located on a large forest tract in the Adirondacks or elsewhere in New York State. This period offers exceptional opportunities for advanced work. The remainder of the third term is spent at Ithaca. The sequence of courses, and other details regarding the professional work, are given in the Announcement of the New York State College of Agriculture, which may be obtained from that college. Prospective forestry students should provide themselves with this Announcement, and should write to the Department of Forestry for general information regarding the course of study which they would need to pursue and the term in which to begin work in order to meet their special needs.

A forestry building, for which \$120,000 was appropriated by the State, was occupied at the beginning of the year 1914-15. The building provides ample laboratory facilities for advanced study and research. The department has eight woodlots on the University farm, including stands of white pine, hardwoods, and hemlock; it has also a farm of thirty-eight acres, part of which is open land used for experimental plantations, the remainder being wooded. All these lands are within two miles of the University Campus. Three miles from the Campus the department has 175 acres of open land, which is being used for experimental and demonstration plantations. A forest nursery has been established. There is a good forestry library, including extensive files of forestry periodicals; and an ample collection of forestry instruments. The vicinity of Ithaca offers excellent opportunities for field studies in several types of forest.

The training preliminary to graduate work in forestry should include all the forestry courses indicated below excepting forest management, forest administration, seminary, advanced work and research. Satisfactory preparation is required in the following allied subjects or their equivalents: English, inorganic chemistry, solid geometry, trigonometry, plain and topographic surveying, introductory physics, dynamic geology, mineralogy and lithology, general botany, plant physiology, general biology, zoology, general entomology, economics.

The Farm Woodlot; Elements of Forestry, Mensuration and Management; Elements of Forestry, Silviculture; Utilization; Conservation; The Field of Forestry.

Wood Technology. Professor RECKNAGEL.

Forest Utilization. Professor RECKNAGEL.

Forest Engineering. Assistant Professor BENTLEY.

Forest Mensuration. Assistant Professor BENTLEY.

Timber Trees and Forest Regions. Assistant Professor BENTLEY.

Silviculture: Forest Ecology. Professor SPRING.

Silviculture: Natural Reproduction and Care of the Forest. Professor SPRING.

Silviculture: Forest Planting and the Forest Nursery. Professor SPRING.
Forest Protection. Professor HOSMER.

Forest Policy, Forest Law, and History of Forestry. Professor HOSMER.

Forest Management. Professor RECKNAGEL.

Forest Administration. Professor RECKNAGEL.

Seminary. Professors HOSMER, SPRING, RECKNAGEL, and Assistant Professor BENTLEY.

Advanced Work and Research. Professors HOSMER, SPRING, RECKNAGEL, and Assistant Professor BENTLEY.

RURAL ENGINEERING

Professors: H. W. RILEY; B. B. ROBB.

Instructors: L. E. HAZEN; J. L. STRAHAN; J. C. MCCURDY; W. A. MORDOFF.

The laboratory equipment for mechanics—consisting of gasoline engines, spray machinery, pumps, hydraulic rams, water supply systems, steam engine, steam injectors, grain binders, separate binder attachments, plows, separate plow bottoms, and other apparatus of similar nature—is selected primarily for teaching the elements of applied mechanics.

A limited amount of laboratory space is available through the winter for research; more room can be provided for summer work. The apparatus now on hand for advanced work consists of a Schaeffer and Budenburg recording traction dynamometer and the Cornell Sprayograph, a power-driven focal plane or curtain-shutter for testing the performance of spray nozzles, the records taken being fifty-two inches square. A limited amount of additional special apparatus each year as required for particular investigations may be designed and built, or bought, without expense to the student. Because of limited storage space very little bulky machinery is retained through the winter but loans of implements of any kind are easily secured for investigations through the summer.

The preparation required of candidates for advanced degrees in mechanics will vary somewhat with the character of the thesis subject. For problems involving the design of new machines or implements or the comparison of existing ones, there will be required a good working knowledge of mechanical drawing, kinematics, mechanics, and machine design, in addition to an adequate understanding of the purely agricultural features of the work. For problems involving the study of the economic value of certain types of implements, less stress will be laid on engineering preparation and more upon that in farm crops, farm management, and rural economy. Practical farm experience is of almost vital importance for any work in this department. Students deficient in engineering subjects may take necessary work in Sibley College; deficiencies in agricultural subjects may be made up in the College of Agriculture.

The department's equipment for farm engineering consists of fourteen farm levels for use in the elementary course; and for advanced work, an architect's wye level and engineer's light transit for men not well versed in instrument work; while for men competent to use them, there is a fine engineer's transit and a precision dumpy level. In addition, the necessary tapes, pins, axes, and leveling and stadia rods are provided.

The preparation necessary for advanced work in farm engineering, as in mechanics, will vary with the thesis subject. In general there will be required a good knowledge of trigonometry, surveying, physics, soils, farm crops, and general agricultural practices and conditions.

Farm Mechanics; Dairy Mechanics; Farm Engineering; Drainage and Irrigation; Farm Structures.

Research in Farm Mechanics. Professor RILEY.

Advanced Work in Farm Engineering. Assistant Professor ROBB.

ENGINEERING RESEARCH

Professors: R. C. CARPENTER; W. M. SAWDON.

Instructor: P. G. McVETTY.

Engineering research is under the charge of a separate corps of specialists who devote their entire time to this work and to giving advice and assistance to graduate and undergraduate students who are carrying on investigations in the various branches of mechanical engineering. Much of the work in this subject is conducted in the several laboratories described under Experimental Engineering. The equipment and resources of all other departments of Sibley College are likewise available, and in most instances arrangements can be made to use the equipment of the scientific and engineering departments of the other colleges of the University.

In addition to the well equipped Sibley College library containing reference books, periodical literature, bulletins and transactions of bureaus and societies, relating to mechanical and electrical engineering and allied branches of learning, the graduate student has access to the University Library and to the special libraries of the other engineering and scientific departments of the University. In the University Library is a large collection of research theses and the Department of Engineering Research has on file the results of many investigations.

(See also courses in Experimental Engineering.)

Motor Car Construction; Heating and Ventilating.

Engineering Research. Professors CARPENTER, and SAWDON and Mr. McVETTY.

Power Plant Testing. Professors CARPENTER and SAWDON and Mr. McVETTY.

EXPERIMENTAL ENGINEERING

Professors: HERMAN DIEDERICH; G. B. UPTON; V. R. GAGE.

Instructors: A. C. DAVIS; W. J. DIEDERICH; E. H. DIX; W. A. GIBSON; W. H. HOOK; F. E. KLINCK; J. L. LANDT; N. N. TILLEY; C. E. THOMAS.

The Materials Testing Laboratory. This laboratory is equipped for tension and compression tests with an Olsen 300,000 pound machine, an Olsen 100,000 pound machine, a Riehlé 100,000 pound machine, a 200,000 pound Emery hydraulic machine, together with several other machines varying in capacity from 10,000 to 100,000 pounds. For transverse tests there is a Reihlé machine of 200,000 pounds capacity, and a Fairbanks machine of 10,000 pounds capacity. There are an Olsen torsion machine of 200,000 inch-pounds capacity, two Thurston autographic torsion machines, and two Upton-Lewis fatigue testing machines. The equipment includes measuring instruments, such as extensometers, a cathetometer, and other apparatus, such as gas furnaces, and tempering baths, required for the determination of the physical qualities of engineering materials under tensile, compressive, transverse, and torsional stress, and under different kinds of heat treatment.

The Steam Laboratory. In this laboratory there is a 150 H. P. triple expansion Allis-Corliss engine so fitted up that it may be run as a simple, compound, or triple engine, condensing or non-condensing. There are also several smaller engines, including a Russell, a Harriss-Corlis, a Payne, a Troy, a Wickes Bros. automatic engine, and a Laidlaw-Dunn-Gordon steam pump delivering 300 gallons of water per minute against a pressure of 300 pounds per square inch. There are three surface condensers which may be connected with these engines as desired. There is one 35 kw horizontal Curtis turbine and one 15 kw De Laval turbine. These turbines drive electric generators and may be run condensing or non-condensing.

There is a two-stage steam-driven Ingersoll-Rand compressor, and three air-brake pumps of different types, together with meters, nozzles, and other instruments used in testing. This part of the laboratory also contains several fans, including one of the Sirocco type.

The equipment of apparatus and instruments used for engine testing comprises about 70 indicators of different types, about 75 steam gauges, and a number of calorimeters for the determination of the quality of steam, speed counters, tachometers, planimeters, etc., besides a number of dynamometers of various kinds.

The boiler section of this laboratory has one 150 H. P. Babcock & Wilcox water-tube boiler of the marine type, and one 100 H. P. Babcock & Wilcox water-tube boiler of the standard type, both of which are fitted with internal superheaters. There are also one 80 H. P. Heine water-tube boiler and one 25 H. P. Roberts safety boiler connected with a Foster independent superheater. The auxiliary apparatus consists of a Cochrane open heater, a Wainwright closed heater, steam pumps, traps, injectors, etc. A full set of scales, measuring tanks, gauges, flue gas apparatus, separating and throttling calorimeters, pyrometers, etc., complete the boiler equipment.

The Gas Engine Laboratory. The equipment consists of an 8 H. P. Fairbanks gasoline engine, an 8 H. P. Olds gasoline engine, an 8 H. P. Hornsby-Akroyd oil engine, a 15 H. P. Hornsby-Akroyd oil engine, a 16 H. P. Acme gas engine run on producer gas from a 15 H. P. suction gas-producer, an 8 H. P. Ingeco oil engine,

a 30 H. P. gasoline marine engine, and a 30 H. P. three cylinder Westinghouse gas engine with gas producer. The last engine may also be run with illuminating gas. Hot air engines are represented by a Rider and an Ericsson engine. The engine equipment is chosen to give as great a variety as possible in fuel used, types of governing, etc.

The supply of testing instruments includes several outside-spring indicators optical indicators, and a manograph. For temperature measurements there are available high reading thermometers and pyrometers of the expansion and electrical types.

The Hydraulic Laboratory. This laboratory contains the following machines and apparatus: a 6-inch single-stage De Laval centrifugal pump; a 2½-inch two-stage Worthington centrifugal pump; a 12-inch Doble water wheel; a 10-inch Trump turbine; several Pelton wheels and hydraulic rams; sets of weir boxes with various types of weirs and nozzles for the determination of coefficients of discharge; various types of water meters and other apparatus for measuring the flow of water, such as Pitot tubes, Venturi meters, current meters, etc.

The Oil Testing Laboratory. This laboratory contains a Cornell oil-testing machine, a Thurston standard railway testing machine and several smaller Thurston machines. The rest of the equipment consists of several viscosimeters of different types, flash and burning point apparatus, together with the necessary hydrometers and thermometers.

The Refrigeration Laboratory. For the study of refrigeration in all its phases, the mechanical laboratory possesses a very complete York compression refrigerating plant having a capacity of 15 tons of ice, and a two ton York absorption ice machine.

The Cement Laboratory. This laboratory not only contains the ordinary apparatus for the testing of cement and concrete but in addition is equipped with crushing and grinding machinery and a small vertical kiln for making investigations in the manufacture of cement from raw material.

The Fuel Testing Laboratory. This laboratory contains a complete equipment of fuel calorimeters, and other apparatus needed for the determination of the composition and calorific value of fuel, whether gaseous, liquid, or solid.

Manufacture of Engineering Materials; Properties of Engineering Materials (laboratory); Introductory Experimental Engineering (laboratory); General Experimental Engineering (laboratory). Also see Engineering Research.

ELECTRICAL ENGINEERING

Professors: A. GRAY; V. KARAPETOFF; W. S. FORD.

Instructors: W. C. BALLARD; C. B. BENNETT; C. G. BROWN; H. W. BROWN; W. G. CATLIN; R. F. CHAMBERLAIN; W. DEANS, JR.; G. D. FLOYD; R. W. GRAHAM; E. R. PAGE; J. G. PERTSCH, JR.; H. M. SHARP; A. C. STEVENS; F. G. TAPPAN.

The Lecture Equipment. The lecture room is exceptionally well provided with display apparatus and with apparatus especially designed for demonstration purposes. All types of electrical machinery may be operated on the lecture table, and a 60,000 volt transformer is provided for insulator testing.

The Dynamo Laboratory. This laboratory is provided with a great variety of standard and special machines for both direct and alternating current work, along with the necessary meters and control equipment. Among the special pieces of equipment are a street car truck with motors and also a complete outfit for exhibiting in actual operation the multiple unit system of electric car control.

The Standardizing Laboratory. This laboratory is equipped with the necessary potentiometers, galvanometers and standards for the calibration of instruments, and the testing of materials used in electrical work. There is also a G. E. oscillograph for work on wave form.

The Wireless Laboratory. This laboratory has a 5 kilowatt, 500 cycle sending set, also a 2-kilowatt, 60 cycle set, both being equipped with rotary and also with quenched spark gaps. The receiving equipment includes crystal, audion and other detectors. The aerial is about 500 feet long and, by means of some of the new supersensitive apparatus, a receiving range of 5000 miles is obtained.

The power for the various laboratories is obtained from the University Hydro-electric Plant, which contains large three-phase alternators, direct driven by both impulse and reaction water-wheels. This plant is complete in every respect and is used for inspection.

Elementary Electrical Engineering; Theory of Electrical Machinery; Characteristics of Electrical Machinery; Electrical Laboratory; Electrical Design; Generation and Distribution of Electrical Energy; Electric Railway Practice; Engineering Mathematics; Wireless Telegraphy; Special Problems in Electrical Engineering.

Theory of Electrical Machinery. Professor KARAPETOFF.

Characteristics of Electrical Machinery. Professor KARAPETOFF and Messrs. PERTSCH and TAPPAN.

Electrical Laboratory. Professor FORD.

Electrical Design. Professors GRAY and KARAPETOFF.

Engineering Mathematics. Professor KARAPETOFF.

The Graduate Seminary in Electrical Engineering. Professors GRAY and KARAPETOFF.

MACHINE DESIGN

Professors: D. S. KIMBALL; G. R. McDERMOTT; H. D. HESS; C. D. ALBERT; L. D. HAYES; C. W. HAM.

Instructors: L. J. BRADFORD; H. H. CLARK; C. D. CORWIN; A. J. J. VAN DER DOES DE BYE; E. F. GARNER; H. STEPHENSON; T. O. HUSSEY; M. A. LEE; G. C. MILLS; McR. PARKER; F. S. ROGERS; C. G. THATCHER; C. E. TOWNSEND; and H. H. WATERS.

Under this heading is included advanced instruction in structural engineering, plant engineering, naval architecture and the resistance, propulsion and powering of ships.

There are eight well equipped drawing rooms. The Sibley College Library and the University Library have a very complete collection of books on machine design, drawing, construction, naval architecture and marine engineering.

Drawing; Descriptive Geometry; Machine Drawing; Kinematics; Machine Design; Elementary Design and Drawing; Structural and Plant Engineering Design; Advanced Design and Drawing; Ship Design; Speed and Power of Ships; Ship Designing and Drawing; Specifications, Contracts, etc.; Mining Methods and Design.

Plant Engineering. Professors KIMBALL and HESS.

Ship Design. Professor McDERMOTT.

Structure and Strength of Ships. Professor McDERMOTT.

Resistance, Propulsion, and Powering of Ships. Professor McDERMOTT.

Advanced Designing (Structural, Power Plant or Ship). Professors KIMBALL, McDERMOTT and HESS.

POWER ENGINEERING

Professors: A. W. SMITH; W. N. BARNARD; C. F. HIRSHFELD; F. O. ELLENWOOD; R. MATTHEWS.

Instructors: C. H. BERRY; R. E. CLARK; E. T. JONES; C. A. PEIRCE.

The graduate work conducted under this heading includes investigations in engineering thermodynamics, problems in power plant economics, the selection and arrangement of the equipment of power plants and the design of such equipment. The library is liberally provided with reference books, periodical literature, and transactions of engineering societies relating to these subjects.

Engineering Principles; Elementary Heat-Power Engineering; Power Plant Design and Economics; Gas and Steam Engine Design (lectures and drafting); Steam Turbine Design; Steam Boiler Design; Gas Manufacture and Distribution.

Designing and Special Problems in Heat-Power Engineering. Professors SMITH, BARNARD and HIRSHFELD.

Industrial Engineering

Professors: D. S. KIMBALL; H. D. HESS; A. E. WELLS.

Instructor: H. STEPHENSON.

Under this heading is included the consideration of the organization, administration, and equipment of industrial enterprises. The library of the college is well supplied with literature relating to the various branches of this field of engineering, and access may be had to the special libraries on economics in the University Library and in the Department of History and Political Science. Attention is directed to the courses in History and Political Science which may be profitably pursued in conjunction with work in industrial engineering.

In order to take the advanced course in this department, the student must not only have had the equivalent of the undergraduate course in mechanical engineering, but must have had the courses in industrial engineering and economics required of the seniors who elect the special work of this branch.

Industrial Organization; Industrial Administration; Industrial Engineering; Drawing and Design; Safety Engineering and Fire Protection.

Industrial Administration. Professors KIMBALL and WELLS.

Drawing and Design. Professor HESS and Mr. STEPHENSON.

Advanced Industrial Engineering. Professors KIMBALL and WELLS.

Mechanics and Hydraulics

Professors: E. H. WOOD; S. S. GARRETT; R. L. DAUGHERTY.

Instructors: W. R. CORNELL; R. B. DAY; D. R. FRANCIS; H. M. PARMLEY.

Hydraulic investigations along various lines can be carried on in this department. For experimental work there is available the equipment of the mechanical laboratory and the university hydro-electric power plant. This power plant contains a reaction turbine operating under 142 feet head and four impulse turbines operating under 135 feet head. The reaction turbine is a 550 H. P. unit built by the I. P. Morris Co. It is direct connected to a 450 kw alternator. The impulse turbines consist of two 280 H. P. Pelton-Doble wheels driving 150 kw alternators, and two 50 H. P. Pelton-Doble wheels connected to 30 kw D. C. generators.

The libraries of the University have a very complete collection of treatises relating to mechanics, hydraulics, hydro-electric engineering, and to similar subjects. In addition, these libraries contain the more representative engineering periodicals and the transactions of the leading engineering societies of the world.

Mechanics of Engineering; Hydraulics; Hydraulic Turbines.

Hydraulic Turbines. Professor DAUGHERTY.

MACHINE CONSTRUCTION

Professor: A. E. WELLS.

The shops are fully equipped throughout with standard hand and machine tools, selected with the view not only of giving manual instruction but also of illustrating modern manufacturing methods. The pattern shop has recently been completely re-equipped with new benches, lathes, and other power tools. The foundry contains five moulding machines of the various types and is equipped with a two-ton cupola, core ovens, crane, and overhead trolley, as well as with an ample supply of modern flasks and hand tools. The forge shop is equipped with twenty-eight standard forges and also contains a drop hammer, power shears, and punch press. The machine shop is equipped with twenty-five standard lathes, four milling machines of various types, two shaping machines, one large radial drill press, two standard drill presses, one horizontal and one vertical boring mill, two semi-automatic lathes, one automatic lathe, two grinding machines, one automatic gear-hobbing machine, and one key-seater, as well as with an ample supply of hand tools.

Subject to the approval of the professor in charge, students may utilize the equipment of the shops in connection with graduate work.

Foundry Work; Forge Work; Pattern Making; Machine Work; Principles of Manufacturing.

GEODESY AND ASTRONOMY

Professors: O. M. LELAND, Geodesy and Astronomy; H. P. UNDERWOOD, Topographic and Geodetic Engineering.

Instructors: L. A. LAWRENCE; H. T. CRITCHLOW; C. R. MCANLIS.

The geodetic equipment is one of the most extensive in the country. The library facilities in this subject are also unusual, embracing the principal books relating to geodetic work in all parts of the world.

It is expected that the new observatory and geodetic laboratory will be ready for use in the fall of 1916. The observatory is to contain a dome for the equatorial telescope, a transit room with four piers for astronomical transits, and zenith telescopes. It is to be constructed in accordance with the latest practice so as to secure the best obtainable observing conditions.

The geodetic laboratory is to contain vaults for the investigation of standards of length, for clocks, and for gravity and other determinations in which the control of temperature is essential; also, a laboratory with piers for the investigation of instruments, a dark room, a library and a computing room.

The following outlines show various classes of work that may be undertaken in this subject and the character of the equipment.

Geodesy and Geodetic Methods. The works of Crandall, Clarke, Jordan, Helmert, and others may be used for special reading. The publications of the United States Coast and Geodetic Survey and of the International Geodetic Association are available for reference.

Geodetic Astronomy. Determinations of time, latitude, longitude, and azimuth are considered. Chauvenet's, Doolittle's, and Hayford's books on this subject may be used as texts.

In connection with the study of star positions, the library contains an assortment of the standard catalogues of stars and the publications of many of the leading observatories of the world. Direct observations may be made with the equatorial telescope of four and one-half inches aperture. This instrument is also suitable for observations of the positions of comets, the components of the easily separated double stars, etc., and the theoretical studies may include similar topics.

For the practical work at the observatory, the equipment includes, besides the equatorial telescope, an astronomical transit by Troughton & Sims; a meridian telescope and two zenith telescopes by Fauth, one of the latter being adapted to photographic methods; altazimuths by Troughton & Sims and Fauth; a Howard mean-time clock; chronometers by Negus and Nardin; and surveyor's transits, sextants, and auxiliary instruments of various kinds.

Adjustment of Observations. Observations of a geodetic nature will be considered, or this work may be made to apply to other lines of investigation if desired, such as physics, mechanics, and hydraulics. A general treatment of the method of least squares may be given if desired.

Terrestrial Magnetism. A Kew magnetometer, a Barrow's dip circle, and a declinometer afford means for investigating the magnetic elements.

Gravity. One of the piers of the department has been occupied as a gravity station by the United States Coast and Geodetic Survey, and is therefore connected, through Washington, with the absolute determinations made at Potsdam, Germany.

The instrumental equipment for this class of work includes, besides a Kater pendulum, a Mendenhall half-second pendulum apparatus of the pattern used in the United States Coast and Geodetic Survey, the pendulums being swung in a partial vacuum. The literature of this subject is well represented in the library.

Standards of Length. For the study and comparison of measures of length, the metric laboratory is provided with a four-meter comparator with micrometer microscopes and carriage movable transversely to accommodate two or more measures simultaneously, an ice-bar apparatus, etc. The comparator is in a case for protection from sudden changes of temperature, and the laboratory temperature is nearly constant. A four-foot comparator is available for the direct study and graduation of leveling rods.

For the investigation of the behavior of apparatus, especially tapes, under field conditions, and also for the standardization of tapes, a 100-meter comparator has been constructed and the auxiliary instruments are in process of manufacture. The end marks are underground and well isolated from surface disturbance. Micrometer microscopes on the piers above these marks will be referred to them by means of special plumbing apparatus, the tapes being observed directly through the microscopes. In this work, a 50-meter Invar tape will be used, whose standardization has been made with exceptional precision by the National Bureau of Standards.

The graduation of scales, as well as their study, is facilitated by means of a dividing engine made by the Société Générale. For the most delicate graduation work, the large Rogers dividing engine in the Department of Physics is available.

The laboratory standard of length is a steel meter bar of the international type, by the Société Générale. It has been compared with an international prototype at Washington. A Rogers four-inch and decimeter scale on speculum metal, accurately compared, and a brass line-and-end-measure yard are also available.

Investigation of Instruments. In addition to the special equipments mentioned above, considerable apparatus of an auxiliary character for the investigation of instruments is at hand. Notable pieces are the large Dodge-Mayhew level-trier, a spherometer with special adaptation for the study of pivots, a pair of pier collimators, micrometer microscopes, etc. Also, there are the usual engineering instruments of many types, transits, theodolites, heliotropes, levels, and meteorological instruments. For standards of temperature, there are several precision thermometers by Boudin, Tonnelot, and others, some of which have been standardized by the International Bureau at Paris. A special comparator is available for the calibration of thermometers, and there is a pyrometer for the study of high temperatures.

The work arranged especially for graduate students may be divided into the following courses:

- a. Theory of Least Squares and Adjustment of Observations.
- b. Theoretical Geodesy and Geodetic Methods.
- c. Advanced Geodetic Astronomy.
- d. Geodetic Laboratory and Field Investigations.

The character of the work as well as the amount of time to be devoted to it, will be arranged with each student. It is usually desirable that the theoretical

reading be accompanied by illustrative laboratory practice, and in the more advanced portions of his work the student will generally devote most of his time to special investigations.

The preparation necessary for graduate work in geodesy and astronomy should include, in particular, general courses in physics, chemistry, and mathematics (including differential and integral calculus), as well as the usual undergraduate work in surveying and mechanics. The ability to read German scientific works is almost indispensable.

Elementary Surveying; Advanced Surveying; Topographic, Hydrographic, and Geodetic Survey (Camp); Survey Computations and Mapping.

Least Squares: Adjustment of Observations. Assistant Professor UNDERWOOD.

Advanced Topographic Surveying. Assistant Professor LELAND.

Geodesy and Geodetic Laboratory. Assistant Professors LELAND and UNDERWOOD.

Geodetic Astronomy. Assistant Professor LELAND.

APPLIED MECHANICS AND HYDRAULICS

Professors: I. P. CHURCH; S. G. GEORGE; A. P. MILLS; E. W. RETTGER; E. W. SCHODER; F. J. SEERY; K. B. TURNER; C. L. WALKER.

Instructors: J. F. BRAUNER; H. E. HAYES; H. V. HOTCHKISS; E. R. STAPLEY.

The technical library in Lincoln Hall contains a full collection of the important books dealing with applied mechanics and hydraulics, complete sets of all representative engineering periodicals, journals of the principal technical societies, and government reports on technical investigations.

The **Cement Laboratory** contains machines for tension tests, compression machines of from two to two hundred tons capacity, and an impact machine. For direct experiment with cement there is also provided a large number of tension and compression briquette moulds, a water tank with capacity for the storage of three thousand briquettes, a moist oven with a capacity of seven hundred briquettes, and three drying ovens; scales; slate and plate-glass mixing tables, thermometers, several sets of apparatus for measuring linear and volume changes during setting, and apparatus for determining specific gravity, normal consistency, and time of set, and constancy of volume by normal and accelerated tests; also standard sieves for determining fineness, and apparatus for determining voids in sand and stone.

The **Equipment of the Testing Laboratory** for materials of construction and for full sized members, joints, and structures includes a Riehle 400,000 lb. testing machine with a capacity for beams and girders up to 19 inches in width and to 18 feet in length and for specimens in tension and compression up to 12 feet in length; a Riehle 100,000 lb. testing machine, and an Olsen 50,000 lb. machine; an Olsen 10,000 lb. wire testing machine; a Thurston autographic torsion testing machine; a Riehle torsion testing machine of 60,000 inch-pounds capacity, for testing rods and shafts up to one and one-half inches in diameter and six feet in length; a Riehle 5,000 lb. transverse load testing machine for flexural tests of bays of wood and metal up to four feet in length; and an Amsler-Laffon compression testing machine.

The equipment for testing road and pavement materials includes two standard rattlers for paving brick, a standard Deval machine for impact and abrasion tests of road material, a standard Dorry machine for hardness tests of rock, an impact machine for tests of rock, an impact machine for determining the cementing value of rock debris, and the following standard equipment for preparation of rock specimens—a ball mill, a briquette forming machine, a diamond core drill, a diamond saw, a carborundum grinder, a grinding lap, and a hand crusher. For tests of bitumens a complete equipment is provided including Engler Viscosimeter, a N. Y. Test. Lab. Penetrometer, a N. Y. State Board of Health Oil tester, a float apparatus, a centrifuge extractor of bituminous aggregate, a melting point apparatus, constant temperature oven, analytical balance, etc.

The equipment also includes a set of torsion clinometers for use with the Riehle torsion machine; a Henning extensometer for tension tests of metals, and two self-indicating dial extensometers with fittings which adapt them for use in testing steel or iron tension or compression specimens, and also for testing full sized concrete beams and columns and for tests of wire. The Martens mirror extensometer is also available. Knock-down forms are provided for the making of large concrete beams and columns.

Mechanics of Engineering. Professor CHURCH, Assistant Professors GEORGE and RETTGER, and Messrs. BRAUNER, HAYES and HOTCHKISS.

Materials Laboratory. Assistant Professor MILLS, and Messrs. BRAUNER and STAPLEY.

Hydraulics. Professor CHURCH and Assistant Professors GEORGE, RETTGER, S. HODER, and Messrs. BRAUNER, HAYES, and HOTCHKISS.

Materials of Construction. Assistant Professors MILLS and WALKER, and Mr. BRAUNER.

Advanced Mechanics. Professor CHURCH and Assistant Professor RETTGER.

Special Courses in Advanced Mechanics for Graduates. Professor CHURCH.

Engineering Problems. Professor CHURCH, and Assistant Professors GEORGE, RETTGER, and TURNER.

Testing Materials. Professor CHURCH, and Assistant Professor MILLS.

Hydraulic Constructions. Assistant Professor SEERY.

Water Power Engineering. Assistant Professor SEERY.

Engineering Design in Hydraulic Engineering. Professor CHURCH and Assistant Professors GEORGE and RETTGER.

EXPERIMENTAL HYDRAULICS

Professors: E. E. HASKELL; E. W. SCHODER; K. B. TURNER.

The Hydraulic Laboratory. The unique location and construction of this laboratory render practicable investigations requiring a steady gravity water supply for long periods using relatively large flows of water. The water supply is obtained from Fall Creek with a watershed of 126 square miles. Beebe Lake, a pond of about 20 acres, has been formed by the construction of a concrete dam 26 feet high, with a spillway crest length of 130.5 feet. At one end of the dam there is an additional flood spillway 141.5 feet long. A rectangular canal 420 feet long and 16 feet wide is supplied from Beebe Lake through six headgates for controlling the amount of flow. The upper portion of the canal is 17.7 feet

deep and the lower portion is 10 feet deep. In this canal are two sharp crested weirs, 16 feet long, over which discharges as large as 400 cubic feet per second may be passed.

A short branch canal 6 feet wide, in the upper portion of the laboratory building, may be supplied directly from Beebe Lake by means of a 48-inch cast iron pipe line with a short 30-inch branch at its lower end. A 30-inch valve controls the flow from the 48-inch pipe into the 6-foot canal. The 6-foot canal discharges either to waste into the pool below Triphammer Falls (a sheer drop of 60 feet) or into the upper end of a steel stand-pipe 6 feet in diameter and 60 feet high. A suitable mechanism causes an instantaneous diversion of discharges as large as 60 cubic feet per second from the waste flume into the standpipe or vice versa. The 6-foot standpipe is provided at the bottom with a 36-inch discharge valve operated by hydraulic pressure. There is a float gauge indicating accurately the height of the water surface in the standpipe. An independent 10-inch pipe line from Beebe Lake to the bottom of the laboratory supplies the majority of the pieces of apparatus used for class work and research. The 6-foot standpipe may be used also as a supply tank, water being supplied to it either from the 6-foot canal or the 10-inch pipe line.

The lower portion of the large 16-foot canal, 350 feet long between weirs, is used for measurements with floats and current meters. An electrically operated car spans this canal and is used for rating the current meters. Models of dams may be built in the canal and the flow over them investigated with precision.

In the laboratory building there is also a concrete flume 2 feet wide, 4 feet deep, and 25 feet long. Flows up to 11 cubic feet per second can be passed through this and measured volumetrically. This flume is conveniently arranged for experiments on small weirs, low head orifices, etc.

There are numerous flanged connections from 4 to 12 inches diameter for the attachment of apparatus.

The hydraulic machinery equipment at present includes only types of the turbine, Pelton-Doble wheel, multi-stage centrifugal pump and hydraulic ram, all arranged for testing.

Prospective graduate students should bear in mind that only under very rare circumstances can a candidate for the Master's degree, or even the Doctor's degree, hope to handle an experimental investigation in hydraulics involving large flows of water up to the capacity of the laboratory or involving extensive constructions. The limitations of seasonal availability of water and of weather conditions, as well as of time, labor, and expense, are such that the graduate student in this subject should look forward to investigations of lesser apparent magnitude, but often of equal value.

Hydraulic Measurements. Assistant Professors SCHODER and TURNER.

(This laboratory course is a prerequisite to the other more advanced and specialized work.)

Experimental Hydraulic Motors and Pumps. Assistant Professors SCHODER and TURNER.

Experimental Hydraulic Investigation. Assistant Professor SCHODER.

Advanced Experimental Hydraulics. Professor HASKELL and Assistant Professor SCHODER.

Sanitary Engineering

Professors: H. N. OGDEN; C. L. WALKER.

The courses offered to graduate students may be divided into two classes; those dealing with the design, construction, and operation of sewage disposal plants and of water purification plants; and those fundamental studies in chemistry, biology, and bacteriology, which the undergraduate student in civil engineering may not have been able to pursue.

A sewage-disposal plant in the city of Ithaca offers opportunity for experimental study of septic action and of sedimentation. Within a short distance from Ithaca are five other plants, well adapted for critical examination of efficiencies. Numerous other opportunities are offered for the study of similar questions.

The laboratories in all the related subjects are open to graduate students in sanitary engineering. The courses in organic chemistry are well adapted to the study of the disposal of trade wastes. The courses in mycology and botany afford excellent opportunity for studying the life history of algæ and other water plants which affect both stream pollution and purification. The courses in bacteriology deal not only with water bacteria and the colon types but also with pathogenic forms interesting from the point of view of epidemiology. The courses in the Medical College enable the student to trace the effect of the pollutions of water supply and to acquire a working knowledge of the water-borne diseases. Finally, a well equipped sanitary laboratory, established in the College gives an opportunity for students to acquire not merely laboratory technique in water analysis, but also a practical training in the forms of interpretation. This laboratory is also available for experimental studies of the efficiency of water and sewage plants and of methods of dealing with the refuse from factories. The library is well provided with the literature of the various subjects bearing on municipal sanitation.

The following courses in other subjects in the University may profitably be taken by graduate students in sanitary engineering: History and Political Science 76a; History and Political Science 54a; Chemistry, 30; Chemistry, 75; Botany, 11; Entomology, 19; Medical College, course 43.

In order to take advanced work in this department, the student must have had an equivalent of the preliminary courses listed below.

Sanitary Biology; Municipal Engineering; Purification and Control of Water Supplies; Sewerage Works; Sanitary Laboratory; Sanitary Design.

Municipal Engineering. Professor OGDEN.

Purification of Water. Professor OGDEN.

Special Laboratory Work. Assistant Professor WALKER.

RAILROAD AND HIGHWAY ENGINEERING

Professors: F. A. BARNES; W. L. CONWELL.

Instructors: J. E. PERRY; E. C. WHITE; CARL CRANDALL.

The library contains an excellent collection of books, technical periodicals, and publications of engineering societies on railroad and highway construction and maintenance, and on railroad operation. Reports of cities and of State Highway Commissions and specifications for the construction and maintenance

of roads and pavements are also available. Standard plans and other data have been contributed from time to time by railroad companies and others.

Maps and profiles of location surveys, many of them relocations of existing lines, are on file in the office of the department and form an excellent basis for the study and comparison of alternate routes and for economic design. Surveys for structure sites and equipment for gathering additional data are available.

Highway Laboratories. The laboratory for testing rock and other non-bituminous highway materials is equipped with a Deval machine, Page impact machine for the toughness test, impact machine for the cementation test, ball mill, core drill, diamond saw, grinding lap, Dorry machine, briquette molding machine, rattler for brick testing, and sieves for examination of aggregates.

The bituminous laboratory is housed in a separate building devoted solely to this purpose and at present is equipped with an Engler viscosimeter, drying ovens, a New York State Board of Health oil tester, balances, a New York Testing Laboratory penetrometer, molds for the float test, etc., bitumen extractors, equipment for distillations, and sieves for examination of sheet asphalt mixtures and aggregates of bituminous concretes. During this year much other equipment will be added, thus enabling the student to make the standard tests of bituminous materials and bituminous paving mixtures.

The other laboratories of the College of Civil Engineering for the study of the strength and other properties of materials and the Ceramic Laboratory of the Department of Geology, which is equipped with kilns and a brick machine, are also available for the use of students specializing in this field.

Attention is called to the facilities available in other departments of the University to supplement the work below outlined; as for example, in political science, the course on railroad transportation and, in electrical engineering, courses dealing with the application of electricity to the operation of railroads.

Special courses of investigation and study will be arranged to meet individual needs.

Railroad Surveying. Construction and Economics. Prerequisite for graduate work.

Railroad Maintenance of Way. Professor BARNES, and Mr. PERRY.

Railroad Operation and Management. Professor BARNES, and Mr. WHITE.

Highway Engineering. Professor BARNES, Assistant Professor CONWELL, and Mr. PERRY.

(These three courses will not be accepted as part of a major subject unless they are accompanied by special work and reports.)

Railroad Engineering Design. Professor BARNES, Mr. PERRY, Mr. WHITE, and Mr. CRANDALL.

Highway Laboratory. Professor BARNES, Assistant Professor CONWELL, and Mr. PERRY.

Highway Engineering Design. Professor BARNES, Assistant Professor CONWELL and Mr. PERRY.

Bridge Engineering

Professors; H. S. JACOBY; E. N. BURROWS.

Instructors: L. C. URQUHART; W. E. BEITZ; C. H. KNOETTGE.

In this subject, instruction is offered in the determination of loading, stresses, and design of roofs, buildings, bridges, arches, foundations, piers, retaining walls, and other structures of timber, steel, reinforced concrete, and masonry.

A collection of over seven thousand blue prints is available, giving detail plans of American railroad and highway bridges, roof trusses, steel buildings, and various structures of reinforced concrete and masonry, and there are also about one thousand selected photographs of all classes of bridges designed in this country.

The twenty-six bound volumes of blue prints used for office reference by the late George S. Morison, which contain the plans of all the bridges designed under his direction as consulting engineer, form a part of the reference library.

The library contains practically all of the important books on bridge and structural engineering. It also contains a valuable collection of theses, those on original investigations relating to arch bridges being especially noteworthy. These investigations have been conducted so as to form an extended and closely related series. Their results constitute an important addition to previous knowledge of the relative strength, stiffness, and weight of different types of construction, and of the method for their investigation and design. Special facilities are available for the study of secondary stresses in bridge trusses.

To qualify for graduate work in bridge engineering, a knowledge of theoretical mechanics, of the strength of materials, and of engineering construction is required in addition to the preliminary course in structural design named below.

Structural Details, Bridge Stresses, and Bridge Design.

Reinforced Concrete Arch. Professors JACOBY and BURROWS, and Mr. URQUHART.

Higher Structures. Professor JACOBY.

Masonry and Foundations. Professor JACOBY.

Steel Buildings. Mr. URQUHART.

Concrete Construction. Messrs. BURROWS and URQUHART.

Engineering Design. Professor JACOBY, Mr. URQUHART and Mr. KNOETTGE.

ARCHITECTURE

Professors: C. A. MARTIN; O. M. BRAUNER; G. MAUXION (Absent on leave); A. C. PHELPS; GEORGE YOUNG; E. V. MEEKS; CHRISTIAN MIDJO; L. P. BURNHAM; G. R. CHAMBERLAIN; SHEPHERD STEVENS.

Instructors: H. S. GUTSELL; H. E. BAXTER; E. M. URBAND.

Graduate work is offered in architectural design; in the history of architecture, painting, and sculpture; in advanced construction; and in drawing, painting, and modeling in their relation to design in architecture.

Candidates for the Master's degree in architecture must have had preliminary training in the subjects elected for graduate work equivalent to that required in like subjects in this University for the degree of Bachelor of Architecture.

The equipment and facilities within the limits of the work offered or undertaken are of the highest order. In addition to the library and rooms used for lectures, recitations, exhibition purposes, offices, etc., the College of Architecture has nearly fifteen thousand square feet of floor space in studios devoted exclu-

sively to the work in design and drawing. The large studios for the work in drawing from the antique, still life, and from life, are thoroughly equipped with full size plaster casts—several hundred in all—of sculpture from the best periods of the art; particularly from the Greek, Roman, and Italian Renaissance, with examples from the medieval and later Renaissance periods. The equipment for the work in color and modeling, which may be taken only as minor subjects, is also excellent.

Supplementary to the equipment supplied by the University Library there is a very large special library of works on architecture and the allied arts, surpassed by none in its accessibility and direct usefulness as a working and reference library. In addition to the books, portfolios, pamphlets, etc., there are several thousand choice photographs covering the entire field of architecture, about one thousand fine color reproductions of the masterpieces of painting, some nine thousand carefully selected lantern slides, and many original drawings made by masters of design and draftsmanship in architecture, all of which are directly accessible to the student.

All instruction is by direct and personal discussion and criticism thus giving to each pupil the utmost that his teachers and advisers have to give.

Freehand Drawing; Descriptive Geometry; History of Ancient and Medieval Architecture; Elements of Architecture; Shades and Shadows; Water Color Painting; History of Renaissance Architecture; Design; Drawing from the Antique; Masonry Construction; Perspective; Historic Ornament; History of Greek Sculpture and Italian Painting; History of Art in Italy; History of Art North of the Alps; Modeling; Planning of Domestic Buildings; Specifications; Working Drawings; Mechanics, Strength of Materials, Structural Design, etc.; Modern Architecture; Advanced Design; Life Class; Seminary; Historical Seminary; Fire-resisting Construction.

Graduate students who are candidates for the degree of Master of Architecture may elect from the following subjects, but in any case the major subject must be Design or the History of Architecture.

Architectural Design. Professors MEEKS, BURNHAM, and STEVENS.

History of Architecture. Professor PHELPS.

Construction. Professors MARTIN and YOUNG.

Drawing from Life. Professors BRAUNER and MIDJO.

Painting. Professors BRAUNER and MIDJO.

Modeling. Professor MIDJO.

Decoration. Professor MIDJO.

THE MEDICAL SCIENCES

As Presented in the Medical College in New York City

For a full description of the work in the Medical College at Ithaca and in New York City, see the Announcement of the Medical College.

The Medical College in New York City comprises the main building on First Avenue opposite to Bellevue Hospital and the adjacent Loomis Laboratory on Twenty-sixth Street.

The Main Building occupies the entire block between Twenty-seventh and Twenty-eighth Streets on First Avenue, extending back one hundred feet, thus affording an available space of nearly 20,000 square feet on each of its seven floors.

The Department of Anatomy occupies the entire fifth floor. In addition to a commodious and well lighted dissecting room there are numerous smaller rooms for investigation and research in anatomy, histology, and embryology, preparation rooms, storage rooms, etc.

The fourth floor is devoted entirely to pathology and bacteriology. There are several rooms for investigators and assistants, preparation rooms, class rooms, a teaching museum, and a library containing current numbers and many back files of the important journals devoted to medical science, in English, French, and German.

The facilities offered by the departmental libraries in the medical school are readily amplified by use of the various libraries in New York City, several of which are within easy reach of the college buildings. Among these the library of the New York Academy of Medicine, the second largest medical library in the country, is worthy of special mention.

The Departments of Physiology and Chemistry occupy the third floor of the main College building and are equipped with laboratories devoted to the problems of research, in addition to those used by students in the course leading to the M.D. degree. Organic chemistry, physiological chemistry, and chemical pathology are thus specially provided for. One large room is set aside for calorimetry, and another has been equipped as an operating room in connection with the work in experimental physiology.

The lower floors of the main building contain the college offices, the dispensary, lecture rooms, class rooms, and a power plant.

The Loomis Laboratory, besides the pharmacological laboratories for medical students, contains laboratories for research on bacteriology, physiological chemistry, experimental medicine, and pharmacology. Facilities are thus furnished to graduates who may desire to pursue further study or research in the various departments of laboratory investigation.

The second floor of this laboratory is devoted entirely to pharmacology and its allied sciences; the first and third floors provide accommodations for the Department of Experimental Therapeutics with research laboratories for physiological chemistry and chemical pathology. The fourth and fifth floors are devoted to research in pathology, bacteriology, and hæmatology; they also provide ample accommodations for photomicrography.

Bellevue Hospital, whose gates open directly opposite the college buildings, furnishes ample opportunity for extending the problems of the laboratory to the bedside, besides offering many intricate problems for solution in the laboratory.

The Hospital is organized in four divisions, one of which has, by the Trustees of the Hospital, been placed at the disposal of the Faculty of the Cornell University Medical College for medical research and instruction. The services thus intrusted to the College include, continuously, ninety medical beds, ninety surgical beds, thirty-two beds devoted to gynecology, twenty-two beds to genito-urinary diseases, and for one-half the year fifty-four obstetrical beds, together with equal privileges with the other three divisions, giving continuous opportunity for instruction and research, in the wards devoted to the treatment of alcoholic diseases, tuberculosis, and the psychopathic diseases.

New York Hospital. The Medical College, through the courtesy of the Governors of the New York Hospital, has long been accorded certain privileges for instruction in its wards, but on the first of January, 1913, a definite arrangement was established between Cornell University and the New York Hospital, through the donation to the hospital of a generous fund which was presented by Mr. George F. Baker, one of the Governors of the Hospital, upon the condition that hereafter half the entire medical, surgical and pathological services of the institution should be definitely assigned to the Cornell University Medical College for the advancement of its teaching and research.

By the most advantageous arrangement the University nominates the visiting staff and laboratory staff of its division and secures the admission of its students to the wards as clinical clerks, which enables the College to make a definite provision in its courses of instruction and research for work in the New York Hospital, and this is now closely correlated in the curriculum with the similar work which has hitherto been done in Bellevue Hospital. Furthermore, the laboratory staffs of the different departments of the Medical College are placed at the service of the Hospital for the purposes of extending its scientific work. The hospital service thus assigned to the College comprises 100 beds. This service is exceedingly active. It includes several thousand acute and emergency cases brought in annually from a large ambulance and dispensary district. During the past year the New York Hospital extended treatment to 5,609 ward patients, about 2,000 of which afforded operative surgical cases.

The services thus supplied to the College are ample for advanced research as well as for undergraduate instruction.

ANATOMY

Professors: C. R. STOCKARD; I. S. HAYNES; Applied Anatomy, I. STRAUSS; Neuro-Anatomy, W. M. BALDWIN; J. F. GUDERNATSCH.

Instructor: M. T. BURROWS.

Abundant material and sufficient apparatus are available for advanced study and work in the various branches of anatomy, embryology, histology, comparative morphology, descriptive anatomy, and experimental anatomy. Students desiring to pursue graduate work in any of these branches must have had in their college courses preliminary training in general zoology and comparative anatomy. A reading knowledge of German and French is essential.

The laboratories are well equipped with microscopes, projection apparatus, microtomes, thermostats, etc., for advanced anatomical work. There is a good aquarium which makes it possible to conduct experimental studies on lower vertebrates.

New York City offers exceptional advantages for obtaining the material necessary for anatomical work. The large slaughter-houses are accessible for comparative mammalian tissues and organs. The extensive collections of specimens and models in the city museums are extremely helpful and instructive to the advanced student.

The members of the staff offer courses in the various phases of anatomy in which they are especially engaged. The courses offered for the medical students appear in this announcement, and are particularly recommended to those

students who have not pursued work of this kind. Technical and practical anatomical work are fully provided.

Preliminary requirements, Physics, Chemistry and Biology as required for admission to the Medical College.

Morphology; Embryology; Histological Technic; General Histology, Microscopic Anatomy and Organology; Descriptive Anatomy including courses in dissection of the upper extremity, the head and neck, the lower extremity, the thorax, the abdomen and pelvis; Demonstrations on the Cadaver; Live Anatomy; Dissection Review; Topographical Anatomy; Neuro-Anatomy and Neuro-Histology; Applied Anatomy; Organs of Special Sense; Anatomical Research.

Anatomy of the Living Body. Professor STOCKARD.

Special and Topographical Studies of Different Regions. Professor STOCKARD and Dr. MORRILL.

Human Histology and Histogenesis. Assistant Professor GUDERNATSCH.

Comparative Embryology. Assistant Professor GUDERNATSCH and Dr. MORRILL.

Experimental Morphology. Professor STOCKARD.

Anatomy of the Infant and Postnatal Development. Professor STOCKARD.

PHYSIOLOGY

Professors: GRAHAM LUSK; J. R. MURLIN; C. J. WIGGERS.

The physiological laboratory contains rooms furnished with modern apparatus for research in physical physiology, an operating room for aseptic surgical operations on animals, a chemical laboratory principally devoted to researches in metabolism, and a calorimetry room in which there is an Atwater-Rosa respiration calorimeter of small size, adapted for work on children, dwarfs, and dogs. It is also equipped for work in general physiology. The laboratory is open to workers under certain restrictions at all hours of the day and night.

Appropriate minor subjects for students whose major subject is not in physiology, include nutrition with laboratory work, physiology of the respiration and circulation, and general physiology, including physiology of the cell and physiology of reproduction, and physiology of the nervous system.

The library of Professor Lusk, together with a large collection of reprints of articles by various authors, may be freely used by students.

A preliminary knowledge of Anatomy and Chemistry, analytical, organic and physiological is requisite for those who take physiology as a major.

Blood and Circulation; Secretion; Respiration; Nutrition; Metabolism; the Nervous System; Special Senses; Psychic Relations; Seminary.

Physiology of Nutrition. Professor LUSK.

Respiration and Circulation. Professor WIGGERS.

General Physiology, including Physiology of the Cell and of Reproduction. Professor MURLIN.

Physiology of the Nervous System. Professor MURLIN.

PHYSIOLOGICAL CHEMISTRY AND CHEMICAL PATHOLOGY

Professor: S. R. BENEDICT.

Instructors: J. C. BÖCK; E. OSTERBERG.

The laboratories available for advanced work and research in physiological chemistry and chemical pathology include those of the Department of Chemistry, located in the main college building, the laboratory of chemical pathology at the Loomis Laboratory building, the new chemical laboratories at Bellevue Hospital, and a research laboratory in the General Memorial Hospital. These laboratories provide adequate equipment for investigation in a great variety of special problems in the chemistry of the plant, animal or human organism in health or disease, by chemical, physical, or optical methods. In the college library the principal journals relating to these subjects are on file.

Students expecting to pursue investigation in physiological chemistry or chemical pathology should have adequate preliminary training in inorganic, analytical and organic chemistry, as well as in physics, physiology, and physical chemistry, though a study of these latter subjects could be pursued at the college, together with more advanced work in special lines.

Organic and Physiological Chemistry; Research.

Physiological Chemistry. Professor BENEDICT, Mr. BÖCK and Mr. OSTERBERG.

Chemical Pathology: Professor BENEDICT.

PATHOLOGY

Professors: JAMES EWING; W. J. ELSE; O. H. SCHULTZE; J. C. TORREY; M. G. SCHLAPP.

Instructors: W. H. TYTLER; F. M. HUNTOON; A. F. COCA; E. S. L'ESPÉRANCE; J. B. GERE.

The laboratories of pathology occupy the fourth floor of the main building and the third and fourth floors of the Loomis Laboratory. The equipment includes all the means commonly employed in pathological research and much new and original apparatus. Both laboratories are provided with suitable quarters for the care of animals. The departmental library includes about 8,000 bound volumes and a large and valuable collection of monographs and reprints. There is an extensive collection of specimens illustrating pathological histology, much material for histological study, and a museum containing about 1,200 specimens. The recent material from the autopsies at several hospitals is constantly available for study, and furnishes a supply of problems in many fields, which is practically inexhaustible. Applicants who have been admitted to the Graduate School are urged to present the degree of Doctor of Medicine for admission to these courses. A limited number of fellowships is available in this department.

Preliminary requirements: Anatomy, including Histology and Embryology.

General Pathology; Special Pathology; Pathological Anatomy; Medico-legal Pathology; Autopsy Technics; Experimental Pathology; Bacteriology.

General Pathology. Professor EWING.

Special Pathology. Professor EWING, Dr. L'ESPÉRANCE and Dr. COCA.

Bacteriology. Dr. ELSER and Dr. HUNTOON.

Immunology. Professor ELSER.

Preventive Medicine and Hygiene. Professor TORREY.

PHARMACOLOGY

Professor: R. A. HATCHER.

Instructor: C. EGGLESTON.

The laboratory of pharmacology, in the Loomis Laboratory, is well equipped for general work and research in pharmacology, and special opportunities will be offered for doing work involving the action of drugs on the circulatory system, and methods of biological testing of drugs and medicines, either supplementing or replacing chemical tests for activity and identity.

The departmental library is sufficient for the immediate needs of workers, and its facilities are readily amplified by the College and other libraries near by which furnish every opportunity for extending the work.

A preliminary knowledge of Chemistry and Physics is required.

Materia Medica and Pharmacy; Pharmacology.

Research in Pharmacodynamics of Drugs; Toxicology.

FELLOWS AND GRADUATE SCHOLARS

1915-16

HONORARY FELLOW IN PALEOGRAPHY:

Elias Avery Loew, A.B., Ph.D.

UNIVERSITY FELLOWS

The Cornell Fellowship:

Frederick Ebell Fiske, A.B. (Cornell) 1914 English

The McGraw Fellowship:

Carl Arthur McClain, B.S. (Oregon) 1906; C.E. (same) 1912 Civil Engineering

The Sage Fellowship:

Miss Ruby Rivers Murray, A.B. (Mt. Holyoke) 1912; A.M. (same) 1914 Chemistry

The Schuyler Fellowship:

Royal Norton Chapman, B.A. (Minnesota) 1914; M.A. (same) 1915 Physiology

The Sibley Fellowship:

Charles Roy Reid, B.S. in E.E. (Oregon) 1906; E.E. (same) 1912 Mechanical Engineering

The Goldwin Smith Fellowship:

Ernest Rice Smith, A.B. (Oberlin) 1912 Geology

The President White Fellowship:

Guy Everett Grantham, A.B. (Indiana) 1909 Physics

The Erastus Brooks Fellowship:

Chester Claremont Camp, B.A. (Grinnell) 1914; A.M. (Cornell) 1915 Mathematics

The Fellowship in Architecture:

Gerald Lynton Kaufman, B.Arch. (Cornell) 1915

The Fellowship in Romance Languages:

Ray Preston Bowen, A.B. (Harvard) 1905; A.M. (Cornell) 1915

The Fellowship in Agriculture:

Sarkis Boshnakian (Fellowship reserved from 1914-1915) B.S. in Agr. (Wisconsin) 1914; M.S. in Agr. (Cornell) 1915

Aaron Bodansky, B.S. (Cornell) 1915

The Fellowship in Mechanical Engineering:

Richard Edmund Brown, E.E. (Lehigh) 1910

The President White Fellowship in History and Political Science:

Frank Hyneman Knight, Ph.B. (Milligan) 1911; M.A. (Tennessee) 1913

The Fellowship in American History:

Miss Caroline May Lewis, A.B. (Cornell) 1903

The Plaut Fellowship in Architecture:

Raymond M. Kennedy, B.Arch. (Cornell) 1915

The Fellowships in Greek and Latin:

Frank Hewitt Cowles, Ph.B. (Wooster) 1907

Miss Helen Shaurman Strong, A.B. (Vassar) 1914; A.M. (Cornell) 1915

The Sage Fellowships in Philosophy:

Miss Marion Delia Crane, B.A. (Bryn Mawr) 1911; M.A. (same) 1914
 Delton Thomas Howard, A.B. (Lawrence) 1910; A.M. (Illinois) 1912

The Sage Fellowship in Psychology:

S. Shidadeh George, B.A. (Beirut) 1912; M.A. (Nebraska) 1914

The Fellowships in Political Economy:

Carl Martin Burke, A.B. (Bethany), 1912; A.M. (Kansas) 1913
 Merlin Harold Hunter, A.B. (Muskingum) 1912; M.A. (Princeton) 1913

The Jacob H. Schiff Fellowship in German:

Louis Ernest Wolferz, A.B. (Columbia) 1908

The Edgar Meyer Memorial Fellowship in Engineering Research:

William Cook Andrae, M.E. (Cornell) 1915

UNIVERSITY GRADUATE SCHOLARS**The Sage Scholarships in Philosophy:**

Miss Ellen Baxter Armstrong, A.B. (Cornell) 1915
 Miss Gertrude I. Baker, B.A. (Western) 1914
 Raymond Preston Hawes, A.B. (Brown) 1912; A.M. (same) 1913
 William Curtis Swabey, A.B. (Stanford) 1915

The Sage Graduate Scholarship in Psychology:

Gilbert Joseph Rich, A.B. (Cornell) 1915; A.M. (same) 1915

The Graduate Scholarship in Chemistry:

Miss Sarah Palmer Caswell, A.B. (Wellesley) 1912

The Graduate Scholarship in Latin and Greek:

Miss Gladys Martin, A.B. (Missouri) 1911; A.M. (same) 1913

The Graduate Scholarship in Archaeology and Comparative Philology:

Miss Donnis Martin, A.B. (Missouri) 1911; A.M. (same) 1913

The Graduate Scholarship in Embryology:

Miss Gertrude A. Johnson, B.S. (Northwestern) 1911; M.S. (Illinois) 1913

The Graduate Scholarship in Botany:

Alpheus W. Blizzard, B.S.Ed. (Ohio) 1913

The Graduate Scholarship in English:

Miss Christine Hammer, A.B. (Bryn Mawr) 1912

The Graduate Scholarship in History:

William Dudley Smith, A.B. (Cornell) 1915

The Graduate Scholarships in German:

Miss Charlotte Helen Pekary, A.B. (Cornell) 1915
 Miss Mary Agnes Quimby, A.B. (Bryn Mawr) 1906

The Graduate Scholarship in Mathematics:

Miss Anna Mayme Howe, A.B. (Wells) 1908; A.M. (Cornell) 1911

Special Scholarships in Architecture:

Henry Stern Kirchberger, B.Arch. (Cornell) 1915
 Elton Rockwell Norris, B.Arch. (Cornell) 1913

The Graduate Scholarship in Veterinary Medicine:

Joseph Prestwick Scott, D.V.M. (Ohio State) 1914

ADVANCED DEGREES

1914—15

CONFERRED SEPTEMBER 23, 1914

Masters of Arts

Henry Chalmers, A.B.: The American Immigrant: A Force in Modern Progress.

Albert Francis Coutant, B.S.: The Habits, Life History, and Structure of a Blood-sucking Muscid Larva.

Samuel Kirkwood Cunningham, B.A.: Transverse Coefficients of Expansion of Wires by the Interference Method.

Abigail Margaret Kincaid, A.B.: Diurnal Variation in Auditory Reaction.

Masters of Science in Agriculture

Elizabeth Faith Genung, B.S. in Agr.: A Study of Bacteria Causing Fermentations in Canned Vegetables.

Henry William Schneck, B.S. in Agr.: The Relation of Vigor in Plants to Parasitic Diseases.

Doctors of Philosophy

Elmer Eugene Barker, A.B.: Heredity Studies in the Morning Glory (*Ipomea purpurea*).

Harry Philip Brown, A.B., A.M.: Growth Studies in Forest Trees.

Ralph John Gilmore, A.B., M.A.: Variation in the Attachment of the Pelvic Girdle in *Diemictylus Viridescens*, Rafinesque.

Frank Holt, A.B.: Goethes Satyros, Shakespeare und die Bibel.

Carleton Friend Miller, B.S.: Electrolysis of Certain Inorganic Salts in Liquid Ammonia.

Joseph Rosenbaum, Ph.B.: On Mixed Linear Integral Equations over a Two Dimensional Region.

Arthur Lee Thompsom, B.S. in Agr., M.S. in Agr.: The Cost of Producing Milk on 174 Farms in Delaware Co., N. Y.

James Kenneth Wilson, B.S.: Physiological Studies of *Bacillus radicola* of Soy Bean (*Glycine max* Piper) and of Factors Influencing Nodule Production.

CONFERRED FEBRUARY 4, 1915

Masters of Arts

Elam Jonathan Anderson, A.B.: Standardization of the Heilbronner, Rote Memory, and Word-Building Tests.

Ellsworth David Elston, A.B.: Some Factors Influencing the Initiation and Development of Normal Potholes.

Charles Paul Gustav Giessing, A.B.: Caricature as a Factor in the Period of the Protestant Reformation.

Masters of Science in Agriculture

Oliver Frank Wooley Cromwell, B.S.: Root Growth of Young Apple Trees after July First.

Fritz William Hensel, jr., B.S. in Agr.: The Pecan in the United States.

Tuan Shin Kuo, B.S.: Influence of Certain Salts upon the Development of Nodules on Vetch.

George Norton Wolcott, B.S. in Agr.: Notes on the Life History and Ecology of *Tiphia inornata* Say.

Masters in Forestry

Pan Cheng King, B.S.: Principles of Forest Administration in Selected Countries of Europe, America and Asia, with Suggested Application to China.

Benson Howard Paul, B.S.: An Ecological Study of Typical Forest Plantations in New York State.

Master of Mechanical Engineering

Herbert Byron Reynolds, M.E.: An Investigation of the Flow of Air and Steam through Orifices.

Doctors of Philosophy

Alan Estis Flowers, M.E., M.M.E.: Viscosity Measurement and a New Viscosimeter.

Harvey Nicholas Gilbert, B.S.: The Copper Lakes of Eosin.

Charles Clifford Huntington, B.S., B.Ph., M.A.: The History of Banking in Ohio before the Civil War.

Millard Alschuler Klein, B.Sc.: Studies in the Drying of Soils.

James Kemp Plummer, B.S., M.S., A.M.: The Effect of Oxygen and Carbon Dioxide on Nitrification and Ammonification in Soils.

Joseph Rosenbaum, B.S. in Agr.: The *Phytophthora* Disease of Ginseng.

CONFERRED JUNE 16, 1915

Master of Arts

Christine Alexander, A.B.: A Study of the Sixth Book of Homer's *Iliad*.
Nai Kim Bee, B.Chem.: "P. T. X. Diagrams of the Systems of Ammonia, Lithium Sulphate; Ammonia, Silver Sulphate; and Ammonia, Potassium Iodide.

Ray Preston Bowen, A.B.: Gustave Flaubert's Style in "La Légende de Saint Julien L' Hospitalier."

Chester Claremont Camp, A.B.: On Linear Ordinary Differential Equations.

Mildred Clark, A.B.: Marriage and Troth-Plight in Elizabethan Drama.

Lynwood Gifford Downs, A.B.: Nietzschean Ideas in Modern German Literature.

Daniel Sheets Dye, B.S.: The Decay of Phosphorescence in Willemite as Related to Temperature.

Fae Farnum, B.S.: Cavalier Perspective and Orthogonal Axonometry.

Gladys May Frary, A.B.: The Ascending Fiber Tracts in the Spinal Cord of the Domestic Fowl. (*Gallus gallus*).

Ludlow Griscom, A.B.: The Identification of the Commoner Anatidae of the Eastern United States in the Field.

Ruby Beatrice Hughes, A.B.: A Study in the Local and Seasonal Distribution of Insects with the Aid of Tent-Traps.

Charles Albert Kuchler, A.B.: The Language and Style of Gottfried Keller's *Züricher "Novellen," Sinnegedicht, and "Sieben Legenden."*

Lucile Marshall, A.B.: Women's Work in Horticulture.

- George Burgess Newman, A.B.: The Relationship of the Larval and Imaginal Mouth-parts of the Higher Hymenoptera.
- Lewette Beauchamp Pollock, A.B.: Selected Translations from August Boeckh's "Encyclopadie."
- Gilbert Joseph Rich, A.B.: The Differential Limens of the Volume of Pure Tones.
- Stephen Gottheil Rich, B.S.: Comparative Anatomy of the Gill Chamber of Nymphs of Anisoptera.
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